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ForYou

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What's New and Cooking in

Virtualisation

**Virtualisation + FOSS
The Right Match!**

**libguestfs: The Smart Way
to Handle Guest Images**

**Serve Up that Desktop
with Some SPICE**

**Secure Virtual Machines
with SELinux**

**Who Needs Windows 7?
Linux Offers XP Mode**

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NOTE: Booking of booths and sponsorships shall commence on 1st of March 2010, along with Early Bird discount which will be reduced every two months. Please feel free to call Ms Poonam or Ms Monika on 09312888878 for any queries. They will be more than happy to assist you in suggesting the best package for your organisation.

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Virtualisation

**Virtualisation + FOSS
The Right Match!**

**libguestfs, the Smart Way
to Handle Guest Images**

**Serve Up that Desktop
with Some SPICE**

**Harden virtual machines
with SELinux**

**Who needs Windows 7?
Linux Offers XP Mode**

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LFY CD: Pardus 2009.1

Arguably one of the most user-friendly and well integrated KDE4-based distros around. The release includes: KDE 4.3.4; kernel 2.6.31.11, OpenOffice.Org 3.1.1.5, Mozilla Firefox 3.5.7, GIMP 2.6.8, Xorg 1.6.5, Python 2.6.4, and more...

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LFY DVD: BackTrack 4, Linux Mint 8 & OpenOffice.org 3.2



Claimed to be the most acclaimed Linux security distro to date, BackTrack is a one-stop-shop for penetration testing. Its users range from skilled penetration testers in information security field, government entities and IT.

Mint's goal is to provide an out-of-the-box desktop experience by including browser plug-ins, media codecs, support for DVD playback, Java and other components. Find the ISO images for both GNOME and KDE4 versions inside.

OpenOffice.org 3.2 introduces faster start-up times, improved compatibility with ODF and proprietary file formats, besides improvements to all the components.

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Editorial

Dear Readers,

Rahul got busy with a major electronics event this time, so I've been asked to fill in. You may already be aware of the many BIG announcements made in February. First, the Symbian source code was released as open source. Second, Intel's (or the Linux Foundation's) Moblin and Nokia's Maemo project merged as MeeGo. Third, Android was all over the place at the Mobile World Congress 2010, held at Barcelona. You'll get to read about all this in the FOSS Bytes section. However, one BIG news that you won't get to read anywhere else in this issue, and which has nothing to do with mobile operating systems, is the release of KDE 4.4.

I'll get to the excuses on why we didn't (or couldn't) cover it, later. This release is a grand one with lots of feature additions—most of which aren't even that obvious. For example, the ability to group multiple windows together, enabling different apps to appear as tabs on KWin's title bar.

When I first tried this feature while testing out one of the beta releases a couple of months back, I couldn't figure out the need for it. If you look at it, the task manager lists all the open windows of apps that are running—so, what's the use of further grouping windows together to have them appear as tabs on top of the screen. If I want to switch to another tab to access another application, I can do that by either using the Alt-Tab keystroke, or clicking the respective apps on the task bar.

Fast forward to today, and I find this feature a must-have! Why? Because I've learned of a way to use it. Some apps open two or more windows at a time—for example, Kopete, VirtualBox, etc. The task manager will typically group these apps together to save some real estate—but I don't really have much control on how they are grouped. Then there is OpenOffice.org, on which I typically have a spreadsheet and a few documents open, at once. Now, with the KWin tabbing feature, I can manually group the windows that I am simultaneously working on—helps me become more organised :-)

Another cool feature is the Nepomuk-Akonadi-Strigi combo. Things are still rough, but they don't have that big question mark about their future anymore—I am speaking from the point of view of a regular user, who just wants to get the work done. For example, for the first time, I did manage to use the desktop search quite easily—it always had been a pain. I still had to google

to find ways to fix some issues with both Akonadi and Strigi, but I'm sure distro packagers would be able to iron out these problems easily.

Anyway, an editorial is only a page long so I have

One BIG news that you won't get to read anywhere else in this issue, and which has nothing to do with mobile operating systems, is the release of KDE 4.4.

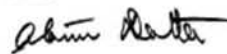
to cut this short. (How Rahul manages to speak his mind every month, within just one page, is a mystery to me.) Since I don't have space to talk about all the things I like and dislike in this release, I'd request you to visit the 'Visual Guide to KDE 4.4' at www.kde.org/announcements/4.4/guide.php. The reason we avoided talking about it in FOSS Bytes is because the above URL is a much better resource.

Why I couldn't write a review is because the month was short, and I wasted too much time in compiling a KDE 4.4 live DVD using SUSE Studio, which never saw the light of day. Our friend, Boudhayan Gupta, told me it worked on his desktop—in fact, it even worked on my desktop, wonderfully. But it just failed to recognise the keyboards and touchpads of all the laptops we tried it on—there's some package I kept missing out on, which I wasn't able to figure out :-)

The idea was to include Firefox 3.6, OpenOffice.org 3.2, VirtualBox 3.1, multimedia apps and codecs, and the whole of KDE 4.4—basically a one-stop-shop for your desktop needs. Let's see if we can figure out the hardware compatibility issues by next month and bundle the Live DVD.

(How do you end an editorial? Oh well...)

Best,



Atanu Datta
Assistant Editor, LFY
atanu.datta@efyindia.com

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You said it...




Maemo

 The Maemo review in the February issue is excellent, coupled with the article on developing applications for it. All the other content also adds up to a solid issue. Congratulations and keep up the great work!

— Saurav Sengupta, saurav.public@gmail.com

ED: We're glad you liked it. Although we wished we had had more time with the device to include a lot more details than we were able to.

OpenLDAP in-depth

 I found the article on OpenLDAP quite interesting. First, thanks for taking the initiative on this. For five years I worked relentlessly on LDAP since the tutorials available in the market were not that great, as far as good examples and practical sessions are concerned. I learnt so many things the hard way. And there's so much more to learn in this vast ocean called LDAP. I don't know if you'd planned to cover the following topics in future articles. I just wanted to mention certain areas that I found difficult to set up and haven't been successful at, as yet:

1. Setting up LDAP over SSL, and how to make applications like Postfix (SMTP) use LDAP.
2. Making containers in OpenLDAP to manage access to machines (desktops/servers).
3. Making DHCP and DNS servers sync with OpenLDAP to automatically update new machines being added to the network via DHCP.
4. Editing *slapd.conf* with any form of GUI instead of manually editing it. ACLs can be only activated after the next restart of *slapd* and it is so much of a trial and error method to add ACLs.

I know these subjects that I am asking for help on are of a very advanced level. But these topics have haunted me for years, especially when they are so easily do-able in Microsoft Active Directory. If you have any documents regarding these, please pass them on. You needn't cover them in *LFY* since the material would be really vast.

— Bejoy Abraham Mathews, bejnet@yahoo.com


Article author, Varad Gupta, replies: Thanks for your wishes and words of encouragement. I hope the other readers feel the same too. As for your queries...

1. I believe an article on SSL/TLS and its workings would be important before we cover LDAP over SSL. Maybe, after the basic LDAP series ends (there are at best one or two more articles) SSL can be covered, and followed up with LDAP over SSL.
2. I guess we can do this in the third article, where we might cover Samba with OpenLDAP, followed by the Windows clients and creating the containers in a fashion that AD does. I can't commit as of now because of time constraints, but this is a brilliant idea and I hope to cover this.
3. In the current version (2.4), ACLs are added in the directory data, instead of *slapd*. Maybe instead of working on a GUI, we could extend the article for Fedora Directory Server—all these features are present there, and I guess we should do this...
4. Again, it's a Windows and Dynamic DNS/DHCP link thing—a very good idea, similar to AD, but will require a certain amount of understanding on the part of the reader regarding dynamic DNS updates through DHCP. Let us see – I cannot commit on this either, and it will also depend on the editors at *LFY*.

Unfortunately, I do not have any documents on these topics, handy. I have started writing these articles in *LFY* to force myself to develop content within specific deadlines. I shall pass this mail to the editor at *LFY* and maybe we could cover these topics over the course of the next few months. But I shall look for good URLs on the Net and pass them on to you for sure. As soon as I write something on these, whether *LFY* prints it or not—I shall pass it on to you. Many thanks for your truly valuable suggestions :-)

ED: We love the topics and are definitely game for it :-D

Online subscription

 I've been a regular reader of *LINUX For You* since 2009. I am from Agartala and here the problem is regarding the availability of the magazine—sometimes I get the magazine in the third week of the month on the

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You said it...



newsstands. So I was planning to subscribe to the magazine. But due to my office work hours, I'm not able to manage this. I was wondering if LFY had an online subscription procedure involving netbanking or a credit/debit card—it will be easier for readers in this part of India.

—Anupam Jamatia, anupamjamatia@gmail.com

ED: You can certainly subscribe online using your credit card at www.linuxforu.com/subscribe-to-the-print-edition-of-linux-for-you. Also, thanks for updating us about the delay in the magazine reaching Agartala—we'll look into what's causing it to arrive late.

'A Voyage to the Kernel' PDFs

I'm a new reader of your magazine. I love it, but there are some problems—many of the articles are in serial format. Obviously, I've missed the earlier parts of these features. Could you let me know where I could get them?

—Misaj, misaj8@gmail.com

I am an engineering student at IIT Patna and am a regular reader of your magazine. I greatly appreciate the work that you do in promoting open source in a world that needs it so badly. Of late, I have been trying to learn Linux kernel programming (which is, of course, a part of the curriculum) and it is one thing that interests me the most. I would like to get the entire set of PDFs of the 'A Voyage to the Kernel' series, if it is available for download, or else, please be kind enough to mail me the same as it would be of great help.

—Sidharth Sharma, ims.sharma@gmail.com

I like the 'Voyage to the Kernel' series and it has motivated me to subscribe to the LFY magazine. On the LFY website, I could find only articles for Days 11, 9, 8, 7, etc. I would like to know if there is a link where I could find all the articles that I've missed out on (from Day 1, to your latest article).

—Thyagu Sundaramoorthy, thyag.js@gmail.com

ED: We understand that our Web team is lagging behind—we'll push them and try to make it current as soon as possible. In the mean time, we hope the earlier PDFs have reached your mailbox. It took us a bit of time to dig through our archives and extract the articles.

Fonts used in code snippets

I'm a subscriber and regular reader of LFY. I'm also a staunch supporter of the open source concept. I have been particularly intrigued by the font used for the computer code published in LFY. Everyone everywhere uses some monospace typewriter font for code, whereas that's not been the case at LFY.

This might seem silly at first, but programmers are used to seeing code in monospace fonts. Usage of any other font makes it hard to read code. Even though you have made efforts to highlight it in blue, I'm afraid it has not helped much. Even text editors such as Vim, Emacs, Gedit and Kate all display the text in monospace. I'm sorry if I am being a little hard on you, but I think it requires immediate change.

—Vikas V. Jois, jois.vikas@gmail.com



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You said it...



ED: Vikas, we must say you nailed us there. We regret that somehow we kept using a sans serif font for code snippets ever since our last design overhaul till the last issue, dated February 2010. However, thanks to your eye for detail, we've changed that with none other than the free (as in freedom) Liberation Mono font face for codes. And, while we're at it, we've also changed the font face for article text (besides headlines, and sub-heads) to Liberation Serif :-). Let us know if you notice the difference.

2009 LFY archive in CD



Once again your bureau has proved its mettle by bundling the [2009] LFY archive in the CD. With this bundled magazine pack, now I can easily share the content by mailing it to people who still can't avail the magazine.

—Ambuj Dubey, dubeyambuj@in.com

ED: We're glad you find it useful :-)

FreeBSD and sysadmin articles




Recently, using the DVD that came with LFY's February 2010 issue, I installed FreeBSD to a virtual platform in Celeron 1.73 GHz, with 512 MB RAM, and a 12 GB HDD. The installation was smooth. Being a Linux user for so many years, it was a bit different trying the C shell. Only after the installation, could I understand why Linux has become so popular.

The server configuration part in your magazine is quite interesting and is helpful for budding sysadmins like me. I search online and try things out also. I've got a few requests for you:

- Can you kindly publish how to configure the X server in FreeBSD? By default, it doesn't boot graphically.
- Please provide an article on security and ethical hacking.
- An article on programming with Qt4 using Python/Perl, etc.
- Penetration OSes like Backtrack, etc, but not on multi-boot DVDs.
- Less pages for the gadgets which many users cannot buy! (Spending 30-35K for the N900, however useful and cool it may be, is probably out of reach for many of your readers.)
- Some article on cloud computing, grid computing, firewalls, routers and home office networks, where users like me can make use of my old Pentium 800 MHz, 160 MB computer.

—Palash Roy, palash737@gmail.com

ED: We'll definitely try to work on the articles you've requested in the coming issues. As for the gadget reviews we've recently started, if you notice, we concentrate more on the OS and its features, rather than going deep into the hardware. Besides, a subset of our readers has long requested us to take up Linux-powered gadget reviews. We are trying to balance everyone's interests :-). **END** 

Please send your comments or suggestions to:

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*10 Lines



Moblin + Maemo = MeeGo

Intel and Nokia are merging their Moblin and Maemo software platforms to create MeeGo, a Linux-based software platform that will support multiple hardware architectures across a wide range of device segments, including pocketable mobile computers, netbooks, tablets, media phones, connected TVs and in-vehicle infotainment systems. The platform is expected to accelerate time-to-market for a range of new Internet-based applications and services, besides exciting user experiences. MeeGo-based devices from Nokia and other manufacturers are expected to be launched later this year.

MeeGo builds on the capabilities of the Moblin core OS and its support for a wide range of device types and reference user experiences, combined with the momentum of Maemo in the mobile industry and the broadly adopted Qt application and UI framework for software developers.

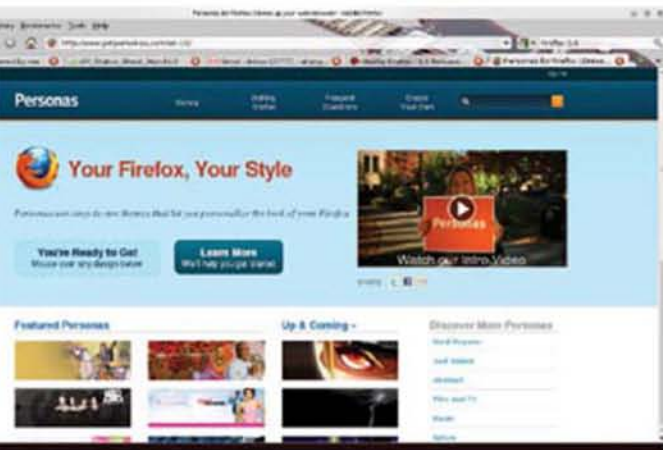
MeeGo also unites the worldwide Maemo and Moblin applications ecosystems and open source communities. For developers, MeeGo extends the range of target device segments for their applications. Using Qt for application development means that they can write applications once and easily deploy them on MeeGo and across other platforms, like Symbian, for example. Developers can begin writing applications for MeeGo in Qt immediately. The first release of MeeGo is targeted for the second quarter of this year. Keep an eye on meego.com, hosted by the Linux Foundation, for updates.

Have you updated to Firefox 3.6 yet?

Mozilla delivered Firefox 3.6 on January 21, 2010, powered by an updated rendering engine, Gecko 1.9.2. The latest version promises "...many improvements for Web developers, add-on developers, and users. This version is also faster and more responsive than previous versions and has been optimised to run on small device operating systems such as Maemo."

The release notes [www.mozilla-europe.org/en/firefox/3.6/releasesnotes] indicate the following important feature additions: support for a new type of theme called Personas; protection from out-of-date plug-ins; open, native video can now be displayed full

screen and supports poster frames; improved JavaScript performance, overall browser responsiveness, and start-up time; support for new CSS attributes such as gradients, background sizing, and pointer events; support for new DOM and HTML 5 specifications; and a lot more.



'We're Linux' returns for the second year in a row

The Linux Foundation has announced the second 'We're Linux' video contest. The theme of the video contest is to demonstrate what Linux means to you and to inspire others to try it. According to the announcement, "The contest is calling all community members and amateur filmmakers to share with the public what a 30-60 second Linux-focused spot for the Super Bowl might look like."

The last date for submission of videos is on April 4, 2010. The winners are going to be announced at this year's 4th annual Linux Foundation Collaboration Summit. The prize is a Linux-powered laptop and a free trip to this year's LinuxCon, scheduled for August 10-12, 2010, at Boston.

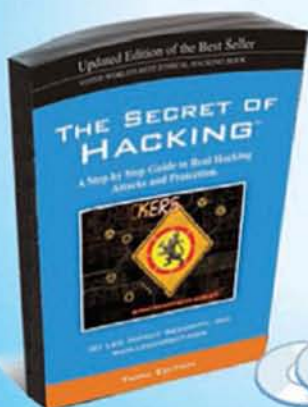
Faster start-up times with OpenOffice.org 3.2

The OpenOffice.org Community has released a new version of its office productivity suite—version 3.2. The new or improved features include: faster start-up times; improved compatibility with open standard (ODF) and proprietary file formats; improvements to all components, particularly the Calc spreadsheet, with over a dozen new or enhanced features; the Chart module (usable throughout OpenOffice.org) that has had a usability makeover and offers new chart types; and many more.

Florian Effenberger, marketing project lead of OpenOffice.org, explains: "Some people are currently locked in to other personal productivity tools—maybe by corporate IT policy, or by a tie-in to other legacy software. For everyone else, we want OpenOffice.org to be the 2010 office software of choice, and 3.2 takes us another step towards that goal."



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Symbian open sourced

On February 4, the Symbian Foundation completed the open source release of the source code for the most widely-used smartphone platform. The move has been completed four months ahead of schedule. Symbian has been developed for more than 10 years and has shipped in more than 330 million devices around the world, before being open sourced.

Any individual or organisation can now take, use and modify the code for any purpose, for a mobile device or for something else entirely. This strategic move provides the Symbian ecosystem with greater potential for innovation, faster time-to-market and the opportunity to develop on the platform for free. Symbian's commitment to openness also includes complete transparency in future plans, including the publication of the platform roadmap and planned features, up to and including 2011. Anyone can now influence the roadmap and contribute new features. Visit www.symbian.org for more details.

You can now download all 108 packages containing the source code from Symbian's developer website (tiny.symbian.org/open), under the terms of the Eclipse Public License and other open source licences. Also available for download are the development kits for creating applications (the Symbian Developer Kit) and mobile devices (the Product Development Kit). These kits are compatible with Symbian^3, the very latest version of the platform, which is now fully open sourced and will be 'feature complete' during Q1 of this year.

Now, run SUSE Studio in-house

Novell has announced the SUSE Appliance Toolkit for ISVs and enterprises.

The Toolkit is a collection of tools designed to make building, testing, updating and configuring appliances, fast and easy. Developers can choose to build their appliances on either SUSE Linux Enterprise or openSUSE.

It features an on-site version of Novell's appliance-building solution, SUSE Studio, and new management tools that enable ISVs and enterprises to reduce software development time, installation cycles and maintenance costs. The Toolkit includes SUSE

Studio Onsite (a local, behind-the-firewall version of the online appliance creation tool), SUSE Studio Online, WebYaST (a tool for enabling remote, Web-based configuration of the SUSE Linux Enterprise), SUSE Lifecycle Management Server (a tool for authentication, entitlement and access control that makes it easier to distribute software patches and updates), and support for KIWI (the image creation tool behind SUSE Studio).

For ISVs, the SUSE Appliance Toolkit is an essential part of the SUSE Appliance Program, which enables ISVs to build, update, configure and go-to-market with fully-supported software appliances. The SUSE Appliance Toolkit is available at www.novell.com/toolkit.



Novel, LPI partner on Linux training and certification

Novell and the Linux Professional Institute (LPI) have announced an international partnership to standardise their entry-level Linux certification programs on LPIC-1. Under this program, Linux professionals who have earned their LPIC-1 status will also satisfy the requirements for the Novell Certified Linux Administrator (CLA) certification. In addition, Novell Training Services has formally agreed to include the required LPIC-1 learning objectives in its CLA course training material.

Adoption of Linux is accelerating as the industry pursues cost-saving solutions that deliver maximum reliability and manageability. A 2009 global survey of IT executives revealed that 40 per cent of survey participants plan to deploy additional workloads on Linux over the next 12-24 months, and 49 per cent indicated Linux will be their primary server platform within five years.

"This partnership represents the strong support the LPI certification program has within the wider IT and Linux community. This historical support has included contributions from vendors such as Novell and has assisted LPI to become the most widely recognised and accepted Linux certification," said Jim Lacey, president and CEO of LPI. More information about acquiring dual certification status can be found at Novell: www.novell.com/training/certinfo/cla, and at the LPI: www.lpi.org/cla.





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VI3 Install & Configure	4 Days
VI3 Deploy Secure & Analyze	4 Days
VI3 VMware Overview	1 Day
VI3 Virtual Desktop Manager	4 Days
VMware Plan & Design	2 Days
VMware Capacity Planner	2 Days
VMware Virtualization Assessment	2 Days

Qt Programme

Qt Programme	Ver 4.6	4 Days
Qt Programme Advance	Ver 4.6	5 Days
Qt for S60		2 Days
Qt Embedded		5 Days

Symbian

Symbian C++ Basics	3 Days
S60 Platform C++ Development	4 Days
S60 Platform 3rd Edition	2 Days

Other Trainings

C/C++	Linux Administration
Java	Linux/Windows Device Drivers
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- ☛ **VMware vSphere 4 : Install, Configure, Manage [V4]**
 - 02nd to 05th March'10 Mumbai
 - 02nd to 05th March'10 Chennai
 - 09th to 12th March'10 Bangalore
 - 17th to 20th March'10 Gurgaon
 - 23rd to 26th March'10 Bangalore
- ☛ **VMware vSphere 4 : What's New**
 - 08th to 09th March'10 Bangalore
 - 23rd to 24th March'10 Chennai
- ☛ **Qt Programme : Qt Programming Ver 4.6**
 - 23rd to 26th March'10 Bangalore
- ☛ **Qt Embedded Ver 4.6**
 - 09th to 11th March'10 Bangalore
- ☛ **Qt For Symbian Ver 4.6**
 - 17th to 19th March'10 Bangalore

April 2010 Training schedules

- ☛ **VMware vSphere 4 : Install, Configure, Manage [V4]**
 - 06th to 09th April'10 Chennai
 - 13th to 16th April'10 Bangalore
 - 20th to 23rd April'10 Hyderabad
 - 27th to 30th April'10 Bangalore
 - 17th - 18th & 24th -25th April'10 Bangalore
- ☛ **VMware vSphere 4 : What's New**
 - 13th to 14th April'10 Hyderabad
 - 27th to 28th April'10 Bangalore
- ☛ **Qt Programme : Qt Programming Ver 4.6**
 - 20th to 23rd April'10 Bangalore
 - 10th - 11th & 17th -18th April'10 Bangalore
- ☛ **Qt Maemo**
 - 07th to 09th April'10 Bangalore
- ☛ **Qt Embedded**
 - 13th to 16th April'10 Bangalore

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Citrix, Novell team up on virtualisation

Citrix Systems and Novell have announced a collaboration that expands choices for customers through increased virtualisation interoperability and new assessment tools. Through this new partnership, Novell has certified SUSE Linux Enterprise Server as a 'Perfect Guest' running on Citrix XenServer and both companies will provide joint technical support to customers. As a result, the more than 4,500 enterprise applications certified as Novell Ready for SUSE Linux Enterprise Server are now Citrix Ready, community-verified, when running in a SUSE Linux Enterprise Server guest virtual machine on XenServer.

The collaboration is strongly supported by leading technology vendors across the IT community such as HP: "Customers require a seamless transition between virtual and physical environments to lower their risk of system downtime," said Scott Farrand, vice president, Infrastructure Software and Blades, HP. "This new capability from Citrix and Novell, when combined with industry-standard HP ProLiant server platforms, will allow organisations to simplify virtualisation management while extending the value of their hardware."

Linus digs the Nexus One

Linus Torvalds hates phones; maybe that's why you've never got a call from him. But he recently fell in love with Google's Nexus One, which is powered by the very kernel he developed. So, let's hear about why he hates phones, from the man himself. On his blog, he explains, "...they are irritating and disturb you as you work or read or whatever—and a cellphone to me is just an opportunity to be irritated wherever you are. Which is not a good thing."

So, did he have a change of heart recently? He bought a phone and wrote, "I have to admit, the Nexus One is a winner. I wasn't enthusiastic about buying a phone on the Internet, sight unseen, but the day it was reported that it finally had the pinch-to-zoom thing enabled, I decided to take the plunge. I've wanted to have a GPS unit for my car anyway, and I thought that Google navigation might finally make a phone useful."

He added, "I no longer feel like I'm dragging a phone with me 'just in case' I would need to get in touch with somebody—now I have a

useful (and admittedly pretty good-looking) gadget instead. The fact that you can use it as a phone too is kind of secondary."



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Red Hat's fourth annual Innovation Awards

Red Hat has announced its fourth annual Red Hat Innovation Awards to be presented at the 2010 Red Hat Summit and JBoss World, co-located in Boston, June 22-25, 2010. The Innovation Awards recognise and honour the creative use of Red Hat and JBoss solutions by customers, partners and the community. Categories for the 2010 Innovation Awards include:

- Optimised solutions—in recognition of striking performance, scalability and/or usability enhancements delivered with open source solutions
- Superior alternatives—in recognition of the most successful migration from proprietary solutions to open source alternatives
- Extensive ecosystems—in recognition of the use of Red Hat or JBoss' expanding partner ecosystem to create innovative architectures based on open source solutions
- Carved out costs—in recognition of customers who have leveraged open source solutions to significantly cut costs and extract added value from existing systems, and
- Outstanding open source architecture—in recognition of the use of Red Hat, JBoss and partner offerings to create innovative architectures based on open source solutions.

Submissions for the Innovation Awards will be accepted until April 15, 2010. Each submission will be evaluated by a panel of representatives and industry leaders. For more information, or to submit a nomination, visit: www.redhat.com/innovationawards.



Mobile World Congress 2010: It was Android all over the place

The blue-eyed boy of this year's Mobile World Congress—held in Barcelona from February 15-18, 2010—was indeed Android. Except for Microsoft, which showcased its new Windows Phone 7 series, most were busy showcasing their devices powered by Google's operating system -- the number of Android-powered devices was reportedly more than 50. The fact that Google CEO, Eric Schmidt, delivered a keynote speech at the conference, speaks for itself.

Taiwanese mobile manufacturer, HTC, announced its two new mobile phones—Legend and Desire, which are to support Flash for the first time. An updated version of Hero was also announced. Legend has somewhat similar features to Hero, with an 81.2 mm (3.2-inch) display and a slightly faster processor—600 MHz compared to the earlier 528 MHz. Instead of a plastic body, Legend uses a unique aluminium frame and replaces the mini trackball with an optical trackpad. However, the big one from HTC was, of course, Desire. This one borrows a number of features from the Google Nexus One: a 94 mm (3.7 inch) AMOLED display and a 1 GHz Qualcomm Snapdragon processor. Moreover, HTC adds the custom Sense UI to Android 2.1 and includes support for Flash 10.1.

Apart from HTC, Acer also updated its Liquid line up, with its new Acer Liquid E. This is basically an upgrade to Acer Liquid, which was priced at Rs 24,990 and powered by the older Android 1.6 OS. The new Liquid E will run on the latest

Android 2.1. The latest version offers a new keyboard layout with extended dictionary support, besides an updated browser with support for HTML 5. The Liquid E weighs only 135 grams and has dimensions of 115 x 62.5 x 12.5 mm. The phone runs on a Qualcomm Snapdragon 8250 processor clocked at 768 MHz, and offers an 88.9 mm (3.5-inch) touchscreen. Additionally, it packs in a 5 MP camera with auto focus. Acer also announced two new devices—beTouch E110 and the beTouch E400. These are entry-level handsets that run Android 1.5. The E110 offers a 71.1 mm (2.8-inch) screen, a 416 MHz processor and a 3MP camera. The E400 runs Android 2.1, a 600 MHz processor and a larger 81.2 mm (3.2-inch) screen.

Mobile phones apart, some companies also showcased new laptops and netbooks. As announced by Dell in CES 2010 in January, the Dell Mini tablet 5 will come with the Android 1.6 operating system along with a 127-mm (5-inch) touchscreen, 5MP camera and built-in Wi-Fi and 3G. HP showcased its Compaq Airline 100 smartbook that is powered by a 1 GHz Snapdragon processor, a 16 GB SSD hard disk, and lot more.

Well, we have only written about a fraction of the Android-based offerings that were on display. So visit www.mobileworldcongress.com/index.htm for more information.



Adobe enters LiMo

Adobe and the LiMo Foundation have announced that Adobe has joined the global consortium of mobile phone industry leaders to bring Flash to the LiMo platform. Support for Flash within the LiMo platform will enable developers and content providers to create applications that can run on LiMo devices. As a member of the LiMo Foundation, Adobe supports the development of an independent, collaboratively developed handset platform that is commercially driven by some of the largest operators and OEMs in the industry, including LG, NEC, NTT DOCOMO, Orange, Panasonic, Samsung, SK Telecom, Telefonica, Vodafone and Verizon Wireless.



KNOW HOW



Q I have just bought a new Compaq 520 laptop. It comes with a Web camera and an inbuilt microphone with speakers. I have installed Ubuntu 9.10 on it that came bundled with *LFY*. Every thing is working fine but I am unable to test my Web camera. I have checked *dmesg* and can make out that Ubuntu has recognised my camera. Can you please suggest a solution?

—Arbab Sen, Ghaziabad

You'll need a webcam application that works on Ubuntu. I would suggest you install Cheese — I think it should have been installed by default. Cheese uses your webcam to take photos and videos; it works with GNOME 2.28 and is built on GStreamer with GTK, Cairo and D-Bus. Just in case it's not already available on your system, install it as follows (provided you're connected to the Internet):

```
sudo apt-get update
```

...and then:

```
sudo apt-get install cheese
```

Q I like to fiddle around with various distros and would like to employ virtualisation for the purpose. However, my system's processor does not have support for hardware virtualisation.

My system has a 2 GHz Core 2 Duo, a 5400 RPM hard disk and 3 GB of DDR2 800 MHz RAM. I am currently running 32-bit Kubuntu 9.10 on it. I was wondering if you could let me know which software-based virtualisation solution will provide the best performance for my needs (from among the FOSS ones, of course :-)), i.e., enable the best performance of the guest OS.

—Saurav Sengupta, Chandigarh

Have a look at VirtualBox. It comes under two licences. The fully open source version is available in the software repository of most Linux distros. Its project website, www.virtualbox.org, hosts the closed-source binaries (which have a few additional features). You can also try their IRC or forum at www.virtualbox.org/wiki/Community for any help needed while installing and configuring it.

Q I have an old assembled desktop PC with a P IV 1.7 GHz processor and 1 GB RAM. The motherboard is Mercury with an Intel 845 chipset. I was trying to install openSUSE 11.1 on the system but wasn't successful. The installation went fine for me but after the first reboot, I could not get the graphical screen to configure my system. I have tried restarting several times but the problem remains the same. I

have installed the same OS on my latest Core 2 Duo-based system and it is working flawlessly. Is there a way to make it work on my old system, too?

—Sudhakar M, Bangalore

openSUSE should work flawlessly on your old system too. I would suggest you set the Frame Buffer Size to 8 MB in the video section of your system BIOS. After setting it, try booting your system—your X should work.

Q I have an Acer E725 (eMachine) that comes with a Pentium Dual core processor and 1 GB of RAM. I have installed Ubuntu 9.10 on it. Everything works fine but I am unable to configure the wireless feature on it. *lspci* shows that it has a Broadcom Wireless (BCM 4211) but *System -> Administrator -> Hardware Drivers* shows that all the drivers work.

—Sonali Roy, New Delhi

To resolve this issue I would suggest the following steps:

- Place your Ubuntu 9.10 Live CD in the drive
 - Open the Synaptic package manager
 - Go to *Settings -> Repositories*
 - Check the option that says *Installable from CD*.
 - Refresh
 - Now search and install the *bcmwl-kernel-source* package
 - Restart your computer
- Next, go to *System -> Administrator -> Hardware Drivers*. Select Broadcom STA and Broadcom fwcuter, click on *Activate* and restart. Configure your wireless network and surf the Web. **END** 

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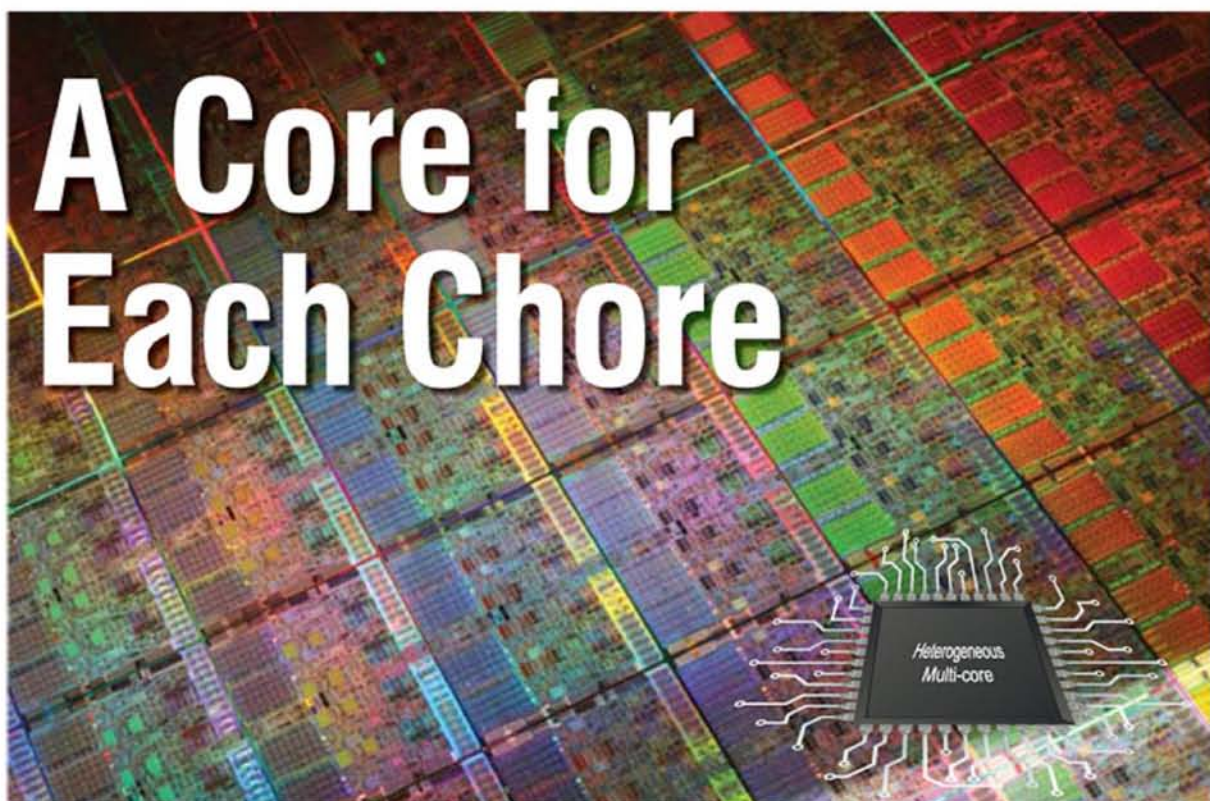


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Dual- and quad-core processors will soon be old hat, with industry majors working towards six-core desktop CPUs and eight- and 12-core server processors, not to forget the prototypes with dozens of cores. Ongoing research also promises highly scalable and customisable heterogeneous multi-core products in the future, complemented with the right parallel programming tools to take advantage of these capabilities.

*H*ave you ever wished you had four hands so you could work faster? A similar sentiment amongst computer engineers was what led to the development of multi-core processors more than a decade ago.

A multi-core processor is essentially a chip that has more than one processor (core) attached to it. By engaging these multiple cores using the right software, a computer can do more in less time.

There is a great demand for multi-core processors across various application domains ranging from general-purpose and embedded computing to networking, digital signal processing (DSP) and graphics. Over the past few years, multi-cores have become the norm, with dual- and quad-core processors being taken for granted even in the desktop and mobile computing spaces.

Of course, we all know that in the computing

world, users are never satisfied. However fast their computers are, they want more speed. When they find four cores mundane, they will have six-core processors, but soon even that will not be enough. Every need will be met by the industry, with more research, more innovations and more products. It is an unending cycle, and no technology is permanent.

Let us therefore stop at this moment in time and capture the current state of affairs in multi-core processors. The situation here is quite similar to the Cola Wars, with Intel and AMD trying to outdo each other with more cores.

A six-mare chariot to pull your computer

Six- and even eight-core processors, per se, are not news any more, with server-focused products such as Intel's Xeon and AMD's Opteron being quite popular. However, it is interesting to note that Intel recently demonstrated a six-core

processor for the desktop segment that is currently being ruled by dual- and quad-core processors. This processor might be launched sometime in March this year.

The processor, codenamed Gulftown, will use Intel's 32-nanometre (nm) fabrication technology and Westmere architecture, which means it will also feature some of the interesting power-saving techniques used in Intel's 45nm products. The power management functions of this architecture will ensure power savings by limiting the power consumed by the idle cores not being utilised by the applications running at any point of time.

Apart from that, the chip has a larger data cache—12 MB of L3 compared to the 4 MB present in its dual-core counterparts. As John Morris and Sean Portnoy observe on their famous blog on laptops and desktops [blogs.zdnet.com/computers], this data cache, when combined with the extra cores, would result in a chip that is larger and contains 1.17 billion transistors. Intel says that it uses some of those extra transistors to speed up tasks like data encryption and decryption.

The six-core processor will also be available in a dual-socket server version.

AMD too plans to launch its six-core desktop CPU this year. Codenamed Thuban, this processor will pack six cores and a DDR3 memory controller onto a 45nm die. It is believed that Thuban will be backwards-compatible with existing AM3 and AM2+ motherboards, which gives a flexible upgrade path to existing AMD users.

Six more for the servers

If six cores is the current high score for desktop CPUs, server-focused processors can boast of six more.

AMD's new server processor, codenamed Magny Cours, is designed for two- and four-socket servers and uses faster DDR3 memory. This processor will be offered in the market as Opteron 6100, in both eight- and 12-core versions. Both chips will be manufactured using a 45nm manufacturing process. The company has also hinted that by 2011, Magny Cours will be replaced with Interlagos—a more powerful 32nm chip that will come with 12 and 16 cores based on AMD's Bulldozer microarchitecture.

The company has also revealed a new Opteron chip (codenamed Lisbon) for servers with one or two processor sockets. This will be available in four- and six-core versions as the Opteron 4100 series. By 2011, Lisbon will be succeeded by Valencia—a 32nm chip offering six and eight cores based on Bulldozer.

A team with multiple capabilities

"Last year, we launched the six-core Istanbul processor; we are currently working on the eight-core and 12-core processors, and plan to launch them by the first half of 2010. Apart from this, we are also planning a six-core desktop CPU. While these homogeneous multi-core processors will continue to evolve over the next couple of years, you will see a movement towards heterogeneous multi-core processors in the future," comments Vamsi Krishna, senior manager, Technical,

Coming up...

1. Six-core processors for desktops
2. Server processors with eight, twelve and even more cores
3. Heterogeneous multi-core processors
4. Smaller, more powerful multi-core chips based on 32nm logic technology
5. Single-chip cloud computers
6. Scalable multi-core architectures
7. Higher-bandwidth I/O and communications, for improved performance of multi-core chips
8. Better parallel programming tools, model-based tera-scale applications and thread-aware execution environments, to make better use of multi-core hardware

AMD. "AMD has plans to release its first heterogeneous multi-core processor (codenamed Fusion), where we integrate multiple x86 cores and graphical processing unit (GPU) cores on a single die. This will be the beginning of a new multi-core revolution in the future."

Deep down, the idea behind Fusion is to enable a mix-and-match strategy at the silicon level, through a broad range of design initiatives. AMD will provide a range of application-specific cores that can easily be combined and heaped onto a processor die and fabricated at a low cost. A quad-core processor might contain different combinations of cores, say, two general-purpose cores and two specialised processor cores, or one general-purpose core and three specialised cores, and so on. This implies that a processor can be put together from heterogeneous cores, based on the end-use and workload.

Krishna adds, "The Fusion project completely leverages the multi-core concept and Direct Connect architecture, enables a homogeneous programming model for all AMD products, and standardises the coprocessor interface for on-die and platform connectivity. Fusion-based processors, with the CPU and GPU integrated in a single architecture, should make the life of software programmers and application developers much easier."

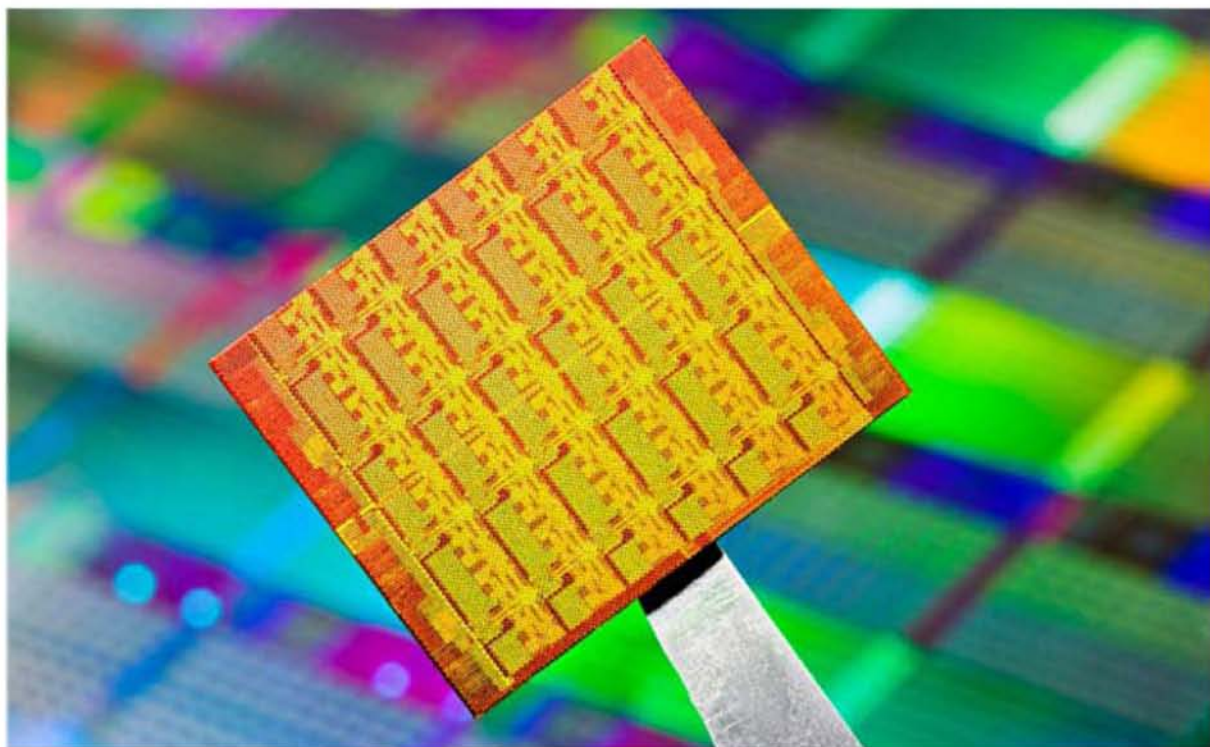
Cloud on a chip

System-on-chips are old news. Now, here is a whole cloud on a chip—Intel's brainchild with 48 cores.

"Most recently, we announced the prototype, single-chip cloud computer (SCC). This research chip contains the most Intel architecture cores ever integrated on a silicon CPU chip—48 cores. It incorporates technologies intended to scale multi-core processors to 100 cores and beyond, while consuming less electricity than two standard household light bulbs," says Vasantha Erraguntla, engineering manager, Intel India.

"Architecturally, the chip resembles a small cluster or 'cloud' of computers on a chip. It was designed as a concept vehicle for parallel software research. We will be working with industry research and academia partners to further parallel computing research using this vehicle."

You might recollect that the same team also successfully tested an 80-core teraflop processor a few years ago. Following that, the team was confident of the success of the



Intel's single-chip cloud computer (SCC) has 48 Intel cores and runs at as low as 25 watts

SCC. However, this chip seems more complex, with a much larger die size, system-level complexities and the challenges of a 45nm physical design to boot. The success of this chip will make processors more scalable than you ever thought possible, and also accelerate multiple-core software research and advanced development.

According to the company, future laptops with processing capability of this magnitude could have 'vision' similar to humans who can see objects and motion as it happens, with high accuracy. Imagine, for example, a laptop with a 3-D camera and display giving you virtual dance lessons or showing you a 'mirror' of yourself wearing the clothes you want to buy online. Twirl and turn to watch how the fabric drapes and how its colour complements your skin tone. This kind of interaction could eliminate the need for keyboards, remote controls or joysticks in gaming. Some researchers believe computers may even be able to read brain waves, so simply thinking about a command, such as the words you want typed, would execute it without the need for speech.

We can expect more breakthroughs from Intel's stable, considering the amount of research being done in this space. "On the hardware side, we explore scalable multi-core architecture that integrates streamlined processor cores and accelerators using a fast, energy-efficient, modular core-to-core infrastructure. Our research is also focused on memory sharing and stacking to provide a high-bandwidth, flexible cache and memory hierarchy that supports many simultaneous threads, fairly and efficiently; and on high-bandwidth I/O and

communications that balance compute demands with the I/O and network demands, within the platform power and cost budgets," lists Errangutla.

The soft side of success

As far as multi-core computing goes, more than half the reason for success depends on the ability of the program to efficiently harness the immense parallel computing power of the processor. "To take advantage of the increasing number of cores, efficient load balancing of software is required. In addition, we need to identify and come up with programs and applications for these systems, to improve performance. It is also important for OEMs to strike a balance between performance and power consumption. We at AMD understand this and are working with our partners to address these issues," says Vamsi Krishna.

Intel, too, has taken several initiatives to educate developers on the specific challenges and techniques of parallel computing, in order to enable them to make good use of multi-core systems.

The multi-core related software research vision at Intel includes "...model-based applications that use tera-scale capabilities to comprehend data, make smarter decisions, and make visual experiences look, act and feel real; parallel programming tools that empower the ordinary programmer to develop applications that use parallelism with scalability and performance, safety and reliability; and thread-aware execution environments that provide real-time performance and power management across cores, and scale with increasing thread and

core counts," informs Erraguntla. You can find more details at <http://techresearch.intel.com/articles/Tera-Scale/1421.htm>.

More than desktops and supercomputers

Multi-core processors are becoming an indispensable aspect of virtualisation too, especially in data centres.

Vamsi Krishna explains, "In the near future, multi-core processors will enable data centres to accomplish tasks more quickly and with greater energy efficiency. Areas such as virtualisation are also primed for a boost by multi-core processors. As AMD moves to eight- and 12-core platforms, far more virtual machines can be packed onto each physical server. By focusing heavily on power efficiency and virtualisation capabilities, businesses can now add performance and efficiency to their business without a significant cost."

R. Ravichandran, director-sales, Intel South Asia, says, "Industry reports point out that there will be approximately 10-15 billion devices in the next four to five years, and most devices like TVs, embedded devices and other consumer electronic devices (beyond traditional desktops, notebooks and servers) will have a link to the Internet. Given that there will be a proliferation of devices in the computing continuum, with rich media and video as killer applications, some of the handhelds and smart phones will need great computing capabilities that are energy-efficient... and multi-core will also pervade these segments."

Ravichandran cites the following examples to prove his point:

- **Safer and smarter roads:** A number of traffic accidents are caused by worn-down car tyres. Intel, along with industry players Kontron and ProContour, has developed a tyre-tread-monitoring embedded technology that is making roads smarter. Kontron, a member of the Intel Embedded and Communications Alliance, has developed a camera with an Intel Core2Duo processor that captures tyre-tread depth as a tyre passes over a specialised grate. This technology can alert drivers when their tyres need replacement to avoid potentially dangerous tyre blow-outs.
- **Medical imaging with multiple cores:** Physicians today collect more complex imagery of their patients than ever before. In order to accurately diagnose diseases and develop treatment strategies in a minimally-invasive manner, new imaging modes, methods and hardware are needed.

In collaboration with the Mayo Clinic, Intel has presented a paper titled Mapping High-Fidelity Volume Rendering for Medical Imaging to CPU, GPU and Many-Core Architectures, outlining how medical imaging benefits from

Multi-core microcontrollers: Powering your car, phone and more


Multi-core technology is no longer confined to high-performance computing or even desktop computing. It has entered the devices that we use every day, in the form of multi-core microcontrollers that are being extensively used in embedded systems.

Several companies, including Renesas Technologies, LSI Corporation, STMicroelectronics and Freescale Semiconductor, have introduced multi-core microcontrollers in the recent past. While the multi-core chips initially introduced for embedded systems were aimed at image processing and other multimedia products with heavy processing loads, recent products are targeted at a broad range of general-purpose devices. These facilitate the true real-time response times required by real-time control systems, safety-critical applications, etc., thanks to their ability to process instructions in parallel.

parallel processing in the Intel micro-architecture codenamed Nehalem. Medical volumetric imaging requires high-fidelity, high-performance rendering algorithms. They have now achieved performance improvements of more than one order of magnitude on a number of large 3-D medical datasets.

What to expect

Look into any device a few years down the line and you will be sure to find a multi-core processor in it. Specialists in the embedded arena, including ARM and RIM, are all launching multi-core models of their processors too.

Multi-core processors have already widened their ambit from supercomputers to desktops, mobiles and data centres. However, the real success and sustainability of the multi-core concept depends on whether it will be ably supported on the software front too, with a proper understanding and execution of true parallel programming principles. Considering the efforts being made by industry leaders to train developers on parallel techniques, this hurdle will be overcome soon, and multi-cores will be adopted even more rapidly. 

The article is the cover story in the March 2010 issue of Electronics For You magazine.

By: Janani Gopalakrishnan Vikram

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Virtualisation and Open Source

What Makes It the Right Match?

Virtualisation continues to be a buzzword. The idea isn't new in itself; IBM mainframes have always had to have a hypervisor. It's in the news now because even simple desktops can now act as virtual machine hosts. A lot of possibilities have opened up as a result. Let's take a brief tour of what virtualisation means, in its classic sense, and look at why open source virtualisation is going to win.

Well, we all know what virtualisation is about—we've read and heard of it over and over again. But let's look at it from the view point of the open source world.

Virtualisation means the simulation of a computer system, in software. The virtualisation software creates an environment for a guest, a complete OS, to execute within this created world. This means the view that should get exported to the guest should be of a complete computer system—with the processor, system peripherals, devices, buses, memory and so on. The virtualisation software can be strict about what view to export to the guest, for example, the processor and processor features, types of devices, buses exported to the guest, etc, or it can be flexible with the user getting a choice to select individual components and parameters.

There are some constraints to creating a virtualised environment or a set of sufficient requirements, as has been noted by Popek and

Goldberg in their paper on virtual machine monitors.

- **Fidelity:** Software running in a virtualised environment should not be able to detect it is running on a virtualised system.
- **Containment:** Activities within a virtual machine (VM) should be contained within the VM itself without disturbing the host system. A guest should not cause the host or other guests running on the host to malfunction.
- **Performance:** Performance is crucial to how the user sees the utility of the virtualising environment. In this age of extremely fast and affordable general-purpose computer systems, if it takes a few seconds for some input action to get registered in a guest, no one will be interested in using the virtual machine at all.
- **Stability:** The virtualisation software itself should be stable enough to handle the guest OS and any quirks it may exhibit. There are several reasons why one would

want virtualisation. For data centres, it makes sense to run multiple servers (Web, mail, etc.) on a single machine. These servers are mostly under-utilised, so clubbing them on one machine with a VM for each of the existing machines enables fewer machines, less rack space and lower electricity consumption.

For enterprises, serving users' desktops on a VM simplifies management, IT servicing, security considerations and costs, by virtue of the reduced expenditure on desktops.

For developers, testing code written for different architectures or target systems becomes easier, since access to the actual system becomes optional. For example, a new mobile phone platform can be virtualised on a developer machine rather than actually deploying the software on the phone hardware each time, allowing for the software to be developed along with the hardware. The virtualised environment can also be used as validation for the hardware platform itself, before going into production, to avoid the costs that arise later due to changes that might be needed in the hardware.

There are several such examples that can be cited for any kind of application or use-case. It's not impossible to imagine a virtualised system being beneficial anywhere a computer is used.

Now is a good time to get acquainted with some of the terms (the mandatory alphabet soup) that we'll be using throughout the article:

- VM – virtual machine
- VMM – virtual machine monitor
- Guest OS – the OS that is run within a VM
- Host OS – the OS that runs on the physical computer system and hosts guests
- Paravirtualised guest – the guest OS that is modified to have the knowledge of a VMM
- Full virtualisation – the guest OS is run unmodified in this environment
- Hypervisor – an analogous term for a VMM
- Hypercall – infrastructure, via which a paravirtualised guest and the VMM communicate

Types of VMM

There are several virtual machine monitors available. They differ in various aspects like scope, motivation, and method of implementation. A few types of monitor software are:

- 'Native' hypervisors: These VMMs have an OS associated with them. A complete software-based implementation will need a scheduler, a memory management subsystem and an IO device model to be exported to the guest OS. Examples are: VMWare ESX server, Xen, KVM, and IBM mainframes. In IBM mainframes, the VMM is an inherent part of the architecture.
- Containers: In this type of virtualisation, the guest OS and the host OS share the same kernel. Different namespaces are allocated for different guests. For example, the process identifiers, file descriptors, etc., are virtualised in the sense that a PID obtained for a process in the guest OS will only be valid within that guest. The guest can have a different

userland (for example, a different distribution) from the host. Examples are OpenVZ, FreeVPS and Linux-Vserver.

- Emulation: Each and every instruction in the guest is emulated. It is possible to run code compiled for different architectures on a computer—for example, running ARM code on a PowerPC machine. Other examples are qemu and pearpc. qemu supports multiple CPU types, and it runs ARM code under x86 as well as x86 under x86, whereas pearpc only emulates the PPC platform.

Virtualisation on x86

Virtualising the x86 architecture is difficult to do since the instruction and register sets are not compatible with virtualisation. Not all accesses to privileged instructions or registers raise a trap. So we either have to emulate the guest entirely or patch it at run-time to behave in a particular way. This was true till about four years back, before virtualisation-specific instructions were added to the architecture.

With the two leading x86 processor manufacturers, Intel and AMD, adding virtualisation extensions to their processors, virtualising the x86 platform seamlessly has become easier. The ideas behind their virtualisation extensions are more or less the same, with the implementation, instructions and register sets being slightly different.

The new extensions add a new mode, the 'guest-mode', in addition to the user-mode and kernel-mode that we had (ring -1 in addition to the rings 0-3, with the hypervisor residing in ring -1). The implementations also enable support for hiding the privileged state. Disabling interrupts while in the guest mode will not affect the host-side interrupts in any way.

Open source virtualisation

Now that we've seen what virtualisation is about and what's needed on the software side to present a virtual machine to a guest operating system, let's talk about the strides open source software has been making in this field.

Xen was the first open-source hypervisor to be announced. The Xen project was started when hardware extensions to virtualisation were not yet available, and the developers took the paravirtualisation approach towards virtualising a system. The Xen team created a new hypervisor, taking bits from the Linux kernel, to run modified Linux guests. A privileged Linux guest called the Dom0, has access to the system hardware and arbitrates the access to physical resources by guest operating systems.

The Xen project got wide acceptance and was backed by a large number of companies—developers from IBM, Red Hat, Novell, Intel, AMD, all contributed to the Xen code base. It was even included in enterprise Linux offerings from various distributions as the supported virtualisation technology.

When the hardware manufacturers on x86 started adding virtualisation extensions to the processors, unmodified guests could be made to run on hypervisors. The deficiencies of the x86 instruction set were masked by these advances.

With this advancement, along came a new line of thought: why have a separate hypervisor, when all a

hypervisor has to do is schedule guests, manage memory and arbitrate access to hardware?

The Linux kernel has been doing all of this for years. Therefore, the kernel code could easily be leveraged to perform all these tasks. And the addition of code to handle the new CPU instructions and state would make Linux itself function as the hypervisor and host VMs.

The KVM project was started for doing just this, and it was evident by the quick developer acceptance that this really is how virtualisation on Linux was finally going to be acceptable. The KVM project was announced in late 2006 and was accepted the same year in Linus' kernel tree. On the other hand, the Xen Dom0 code has yet to find upstream acceptance. The Xen hypervisor, itself bearing Linux code, will always continue to be a separate project.

The open source advantage

A commonly-cited advantage of open source software is the 'more eyeballs' concept. As more people look at the code, bugs become more obvious and get fixed faster, often before the code enters a stable release. This is definitely true. However, there are other advantages when it comes to open source software with large communities, beyond just more eyeballs.

If one follows the LWN.net "Who develops Linux" articles, it's clear that most of the developers are sponsored to work on Linux by companies. It isn't a big surprise to people any more that companies are running businesses and making profits by relying on open source software. Linux already runs on the widest array of platforms—it can run on simple embedded devices and also on big supercomputers, including everything in between. The developers come from not just one part of the world, but from everywhere. The experience, culture and insights they all bring in are invaluable.

Contrast this to a proprietary OS maker. Perhaps all the developers sit in one campus and are probably used to following a particular train of thought. Just one company cannot match the resources that 50 companies (and, of course, the individuals in the community) put together to collaboratively enhance the OS.

Red Hat, IBM, Novell, Intel, AMD, HP, Fujitsu, Oracle, Nokia and Google, all figure on the latest LWN.net compilation for companies that are funding developers to contribute to the Linux kernel. The sheer scale at which the development happens is mind-boggling.


This, however, does not mean that companies can push whatever code they want to into the repositories. Merit wins. There is a peer review of all the patches that flow in. There are people who deeply care about the code that gets accepted. Almost all the patches submitted the first time have to be adjusted after review comments by others. There hardly are patches that go in their unmodified form from the time they were first sent out for review. In many cases, people maintaining subsystems that reject patch submissions could be working for the same company that's promoting the patches. And there's no love lost. Everyone involved understands the prime cause: to create better software.

People understand this, and the companies involved understand this too.

Now why does all this matter in the virtualisation perspective? It's simple. The Linux kernel itself is a hypervisor. Any advances in Linux, the operating system, are directly beneficial to Linux, the hypervisor. By using the KVM technology, guests running on top of KVM can enjoy the benefits immediately when patches get accepted to Linux. KVM guests can already enjoy the support of 64 vCPUs (and more!), huge-page backed memory, a wide range of memory over-commit options, NUMA support and so on. And KVM is just four years old. It has taken other projects many more years to reach the state they currently are in, and even then, they do not offer some of the features that KVM offers. It's an interesting exercise for the reader: compare the feature set as announced in releases of virtualisation software one year back to the current set. The number of features and enhancements KVM can provide in one year's time, others would only dream of achieving in five.

This comes as no surprise. There are two basic mindsets at play. First, the UNIX one: 'Do one thing and do it right'. The KVM developers just focused on providing the best support to exploit the hardware support for virtualisation and left the CPU scheduling, memory management, etc, to Linux. KVM also leveraged the QEMU project heavily that provides a device model. The virtual computer that gets exposed to the guest is provided by QEMU, and KVM developers have heavily updated the upstream QEMU code to enable it to support modern devices, KVM-based guests and a lot of optimisation.

The second philosophy is to contribute as much as possible to upstream software, fighting the urge to ship a forked copy of the codebase with some features that would be deemed controversial upstream, or which would take a longer time to gain acceptance. This might result in some features getting delayed as discussions pan out, and developers pitch in with their opinions on how to do things the 'right' way. But, in the end, the best technical solution wins and maintaining the solution that's accepted by all is easier in the long run. With most enterprise Linux vendors offering seven-year support guarantees, this becomes a big plus. This is because keeping the private functionality in the stable offering working, while also backporting fixes and optimisations from an upstream codebase that changes more and more each day, would soon become a nightmare for the maintainers of the enterprise software.

Just comparing the two open source virtualisation solutions, Xen and KVM, shows us the stark contrast in these principles and the benefits of collaborative development. 

By: Amit Shah

The author is part of the virtualisation team at Red Hat and is excited to be a part of the technology that's rediscovering commodity x86 servers.

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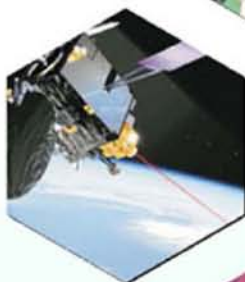


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The Smarter Way to Handle Guest Images

Understanding libguestfs, a library to access and modify VM images.

Most administrators might have experienced the ease of using Sysprep for the automated deployment of Windows-based machines, especially virtual desktops. Automated deployment of virtual desktops and servers in batches is inevitable in an IT infrastructure that has virtualisation. There are certain things that are unique in every guest, like the IP address, hostname, licences, certain configuration file parameters, etc, which need to be updated at the time of deployment.

I had been thinking a lot on what could be the equivalent on the Linux side when it comes to deploying Linux-based virtual machines.

Around this time, I upgraded one of my boxes to Fedora 12 and learned about the availability of libguestfs and guestfish. The interactivity of the utility may not be as robust as Sysprep, and libguestfs alone may not be equivalent to Sysprep in all aspects, but it bridges a big gap in the automated deployment of virtual machines.

Deploying virtual machines from a template has always been a challenge due to the diversity of requirements and use-cases for different machines. The traditional way is to deploy the virtual machine from a predefined general template and customise it later for specific requirements. This is absolutely non-scalable and is a huge burden on the administrator.

libguestfs helps overcome this challenge. Since Anaconda installation is not done while virtual machines are deployed from pre-defined templates, using `kickstart %post` is not an option. libguestfs can be used to automatically make these required modifications inside a guest filesystem before the guest is deployed.

libguestfs is a library used to inspect, modify and manipulate virtual machine disk images. It supports almost all virtual disk formats like the raw image, vmdk (VMware image format), qcow2, LVM block devices, etc, and filesystems like ext2, ext3, ext4, btrfs, FAT, NTFS, etc.

The libguestfs tools

libguestfs provides some tools to manipulate the images efficiently. These are provided through the *libguestfs-tools* package in Fedora and can be used on the guest images non-interactively.

- **virt-rescue:** Launches a shell in the guest image to do rescue operations like editing boot configuration files, modifying initrd images, etc.
- **virt-edit:** Opens the specified file inside the guest image in your favourite editor.
- **virt-inspector:** Gets basic details about the guest from its image, like the kernel version, modules loaded, mount points, details of applications installed in the guest, etc.

Other tools are *virt-cat*, *virt-ls*, *virt-rescue*, *virt-df*, *virt-tar* and *virt-win-reg*—I'm assuming readers will find the names self-explanatory. *virt-win-reg* is used to display Registry Entries from a Windows guest image.

The syntax of how to use *virt-cat* is as follows:

```
# virt-cat <guest image or block device> <file name>
```

For example:

```
# virt-cat f12.img /etc/hosts
127.0.0.1 localhost localhost.localdomain localhost4 localhost4.localdomain4
::1 localhost localhost.localdomain localhost6 localhost6.localdomain6
```

Checking the man pages for the respective tools will provide more details on how to use them.

There are certain tools developed with the help of libguestfs. *virt-v2v* is one of them, and is used to migrate virtual machines running on one platform to another one (for example, virtual machines running on VMware to KVM). libguestfs is used extensively by this tool to modify the filesystem images to run appropriately on the target platform.

libguestfs can be used to inspect a guest filesystem while in offline mode and collect data for administrative purposes.

guestfish

guestfish uses libguestfs to launch a shell on the guest filesystem to help us modify the image efficiently, offline or online. It's recommended not to invoke it on running guests and make

modifications, due to the possibility of filesystem corruption.

You can invoke guestfish on online guests in read-only mode to view details. You can call it from a shell script, invoked from the command line directly, without launching an interactive shell to execute commands inside the guest image. You can also use it to launch an interactive shell on the libguestfs filesystem and execute commands from the shell. Examples of each method are available in its respective man page.

You need to use the `-i` switch to execute guestfish to launch an interactive shell:

```
# guestfish -i f12.img
```

```
Welcome to guestfish, the libguestfs filesystem interactive shell for
editing virtual machine filesystems.
```

```
Type: 'help' for help with commands
      'quit' to quit the shell
```

```
>>fs>
```

Typing help here will display all the available commands inside guestfish and running the help `<command>` will give more details about the specific command.

Troubleshooting

You can also use libguestfs to make modifications inside a guest image for troubleshooting purposes. This makes troubleshooting on a broken guest very easy. An administrator does not need to go into rescue mode to reinstall Grub, make modifications to boot loader configuration files, etc. Let us look at the simple example of a kernel upgrade rendering the system non-bootable. Reverting to the old well-known working kernel is as simple as running the following command:

```
# guestfish -i <guest image/ blockdevice>
```

...and editing the `/boot/grub/grub.conf` file to change the default kernel to boot.

In the same manner, we can reinstall the boot loader on the guest image if it somehow gets corrupted. There is no need to follow the old way of looking for a bootable CD and going to rescue mode to reinstall it. As a matter of fact, this way of recovering a broken production virtual machine becomes much faster compared to recovering a broken physical system. Let us have a look at how we can reinstall Grub on a Fedora 12 guest image.

Use *virt-df* on the image to view the filesystem details of the guest:

```
# virt-df f12.img
```

Filesystem	IX-blocks	Used	Available	Use%
f12.img:/dev/VolGroup/lv_root	6821604	1346828	5128256	24.8%
f12.img:/dev/sda1	198337	21435	186662	16.0%

This shows that the / filesystem of the guest is on /dev/VolGroup/lv_root and /boot is on /dev/sda1.

Next, launch an interactive guestfish filesystem shell on the image by mounting both / and /boot filesystems, appropriately.

```
# guestfish -a f12.img -m /dev/mapper/VolGroup-lv_root -m /dev/sda1:/boot
```

```
Welcome to guestfish, the libguestfs filesystem interactive shell for
editing virtual machine filesystems.
```

```
Type: 'help' for help with commands
      'quit' to quit the shell
```

```
><fs> df
Filesystem      1K-blocks      Used Available Use% Mounted on
/dev/mapper/VolGroup-lv_root
                6821604    1346828    5128256   21% /sysroot
/dev/sda1        198337     21435    166662   12% /sysroot/boot
```

```
><fs> grub-install /dev/sda
```

In the above command, the image or the block device on which the guest is installed should follow the -a switch. Each block device that needs to be mounted from the guest should follow the -m switch in the format of the 'block device:mount point'. We need to mount /boot since the grub-install command installs stage files in the /boot/grub/ directory.

Template

Most virtualisation technologies support deploying virtual desktops from templates using the copy-on-write (COW) method. libguestfs will be very useful in making modifications on the template, running security updates on the template, etc.

For example, let's assume 200 virtual desktops are deployed from a template using the copy-on-write method. While using this method, changes specific to a virtual desktop from the actual template will be stored on a different file. The template will be used in conjunction with the changes on the file to form the guest filesystem. If the kernel needs to be updated on these 200 virtual desktops, it's as simple as taking a copy of the template, using libguestfs to update the kernel on the copy of the template, and changing the template for the guest to use to the new template with the updated kernel. On the next reboot, all the 200 virtual desktops should have the updated kernel. Likewise, making batch changes to configuration files is also very easy, using this method.

Windows support

libguestfs has minimal support when it comes to handling Windows-based images. FAT and NTFS filesystems are fully supported. You can use virt-win-reg to view the values from the Windows registry. For example, I used

the following command to get the product name from a Windows 2003 image:

```
# virt-win-reg windows-2003.img 'HKEY_LOCAL_MACHINE\Software\Microsoft\
Windows NT\CurrentVersion' ProductName
Microsoft Windows Server 2003
```

Partial back-up

Taking a full back-up of a virtual machine is very easy. Just backing up the whole image or taking lvm snapshots or 'dd-ing' block devices will suffice. On physical systems, taking a partial back-up (e.g., taking a back-up of Apache configuration files only) usually involves copying content from inside the virtual machine over the network, using rsync, scp or other back-up utilities. Libguestfs can be used to take a partial back-up of the guest from the host without logging into the guest. However, it needs to be noted that, for a reliable back-up, I strongly recommend that you do not use libguestfs. A back-up agent should be installed inside the guest, like we do with ordinary machines.


Cloning a virtual machine

Cloning a virtual machine is usually done by copying the image of a virtual machine to a different location and replacing details in the image that are unique to a virtual machine, like the hostname, IP address, MAC address, etc. You can use libguestfs to serve this purpose, whereas these unique details will either be replaced with actual details provided by the user or replaced by a placeholder.

Areas for improvement in libguestfs

One thing that I expected to see in libguestfs was support for Solaris filesystems like UFS, ZFS, etc. Unfortunately, it's not available as of now. (Note, that this isn't a libguestfs drawback, *per se*. If Linux has support for them, libguestfs will support them. Also, there are some licensing restrictions when it comes to supporting ZFS.)

Caution

One thing that needs to be kept in mind while dealing with libguestfs is not to make modifications when using it on running guests. There is a strong possibility that this will corrupt the guest filesystem beyond recovery. Future versions of libguestfs will introduce thorough locking to prevent people from doing this. At this moment, it's recommended to always connect to running guests using the --ro switch to guestfish, to prevent modifications. 

Resources

- libguestfs home: www.libguestfs.org
- Richard W M Jones' Blog: rwmj.wordpress.com

By: Sadique Puthen

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Secure Virtualisation with SELinux

There's been much brouhaha over virtualisation. Have you ever wondered what would happen if a single compromised VM compromised all the other VMs running on the same hardware stack?

As the usage of virtualisation increases, the security that isolated physical machines enjoy is at risk. Rogue processes in a guest OS might break out of the virtual machine and get access to the host memory or other guests. Designing security features within hypervisors can control this. But in case of such incidents, the risks can be mitigated by integrating Mandatory Access Controls (MAC) with virtualisation.

With the integration of MAC-capable security schemes like SELinux, with virtualisation, the security position of guest machines can be improved.

Let's take a look at how the scenario might unfold. We can begin by examining the situation as it existed in the good old days when one physical machine ran a dedicated server:

- Before virtualisation, servers were generally physically isolated from each other (Figure 1). An attacker taking over one server would typically have control over just that. So, if he wanted to breach the other machines on the network, he essentially had to launch a network-based attack to exploit them. This limited the damage of network attacks. To avoid these kinds of attacks, administrators used different tools like network firewalls, intrusion detection/prevention systems, and unified threat management systems to mitigate the risks.
- With the advent of virtualisation, several guest machines run on the same single host server (Figure 2), and probably as the same UID. This comes with its own risks. If an attacker gains access to a single virtual

machine, he then just needs to breach the hypervisor running on the host. If there is a hypervisor vulnerability currently existing in the wild, he can exploit it and can thus, eventually, take over the rest of the virtual machines running on the host.

Understanding sVirt

sVirt was introduced as a feature of Fedora 11, and conceived as a security mechanism for Linux-based virtualisation schemes like the (KVM)/Qemu, and lguest. It has been developed primarily by Dan Walsh and James Morris, of Red Hat. Some of the goals/use-cases of sVirt are listed below:

- Providing virtualised services with a level of isolation similar to that previously afforded by physical separation.
- Increased protection of the host from untrustworthy VM guests (for example, for VM hosting providers, grid/cloud servers, etc).
- Increased protection of VM guests from each other in the event of host flaws or misconfiguration. Some protection may also be provided against a compromised host.
- Strongly isolating desktop applications by running them in separately labelled VMs (for example, online banking in one VM and *World of Warcraft* in another; opening untrustworthy office documents in an isolated VM for view/print only).

How does it work?

sVirt essentially works by adding SELinux support to the Linux virtualisation library libvirt. It is designed as a pluggable security framework into the libvirt API (Figure 3). It also supports other MAC security schemes like SMACK (Simplified Mandatory Access Control Kernel), a security kernel module. In a typical use, one ought not to even notice sVirt running in the background.

As you already know, SELinux works by labelling everything like files, devices, processes, etc. The libvirt daemon (*libvirtd*) starts all virtual machines. And all virtual machines run as separate processes. *libvirtd* dynamically generates labels for the image files and starts the virtual machines with the appropriate labels. The SELinux policy has rules that allow the *svirt_t* processes to read/write *svirt_image_t* files and devices.

This allows us to protect the host machine from any of its VM guests. A virtual machine will only be able to interact with the files and devices with the correct labels. A compromised virtual machine would not be allowed to read my home directory, for example, even if the virtual machine is running as the root.

However, this 'type' protection does not prevent one virtual machine from attacking another. We need a way to label the domains and the image files with the same TYPES. Yet, at the same time, we need to stop virtual machine 1 (running as *svirt_t*) from attacking virtual machine 2, which would also be running as *svirt_t*.

This is where the Multi Category Security (MCS) mechanism comes into play. MCS is an enhancement

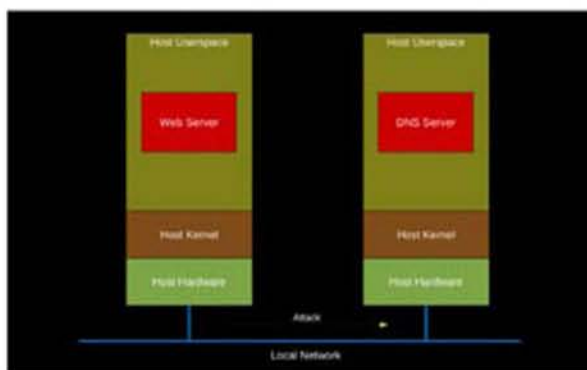


Figure 1: Server set-ups in the absence of virtualisation

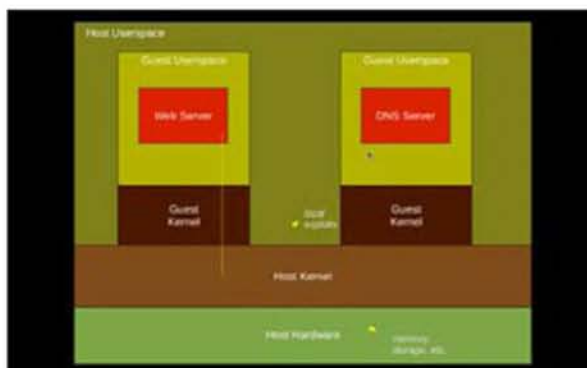


Figure 2: Server set-ups using virtualisation

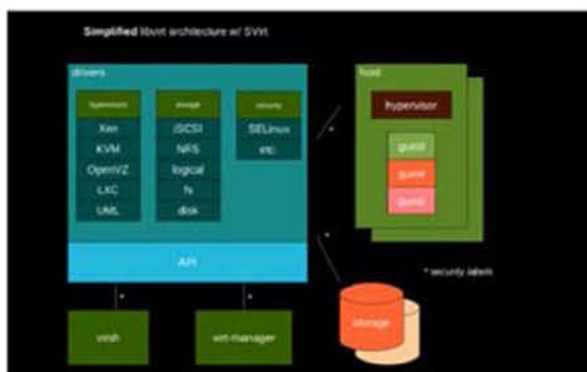


Figure 3: Simplified libvirt architecture with sVirt integration

to SELinux, which allows users to label files with categories. These categories are simply text labels, such as 'Company_Confidential' or 'Medical_Records'. The sysadmin first configures the categories, then assigns users to them, as required. In a nutshell, to access a file, a user needs to be assigned to all of the categories with which the file is labelled.

Note: The first thing the sysadmin will want to do with MCS is configure some categories. This can be done by editing the */etc/selinux/targeted/setrans.conf* file. This file specifies how the internal MCS categories can be mapped to human-

Table 1: Example VMs and their SELinux labels

Name	Virtual Machine process label	Virtual Machine image label
Virtual Machine 1	system_u:system_r:svirt_t:s0:c514,c932	system_u:object_r:svirt_image_t:s0:c514,c932
Virtual Machine 2	system_u:system_r:svirt_t:s0:c101,c230	system_u:object_r:svirt_image_t:s0:c101,c230

readable formats. The following snippet shows the typical contents of the `setrans.conf` file:

```
s0:c0=CompanyConfidential
s0:c1=PatientRecord
s0:c2=Unclassified
s0:c3=TopSecret
```

From the above snippet, the left hand side of the 'equals to' sign is the MCS security level, with the corresponding human readable value on the right. To list the current categories defined on your system, use the `chcat -L` command.

Each VM has unique MCS categories, and the SELinux security policy does not allow interaction between different categories, irrespective of their actual values. The file systems' device/image for each VM is also labelled with the VM's MCS label, to prevent VMs from accessing each other's resources.

Till Fedora Core 5, the typical SELinux context consisted of only three fields: USER:ROLE:TYPE.

Later on, SELinux added one more field, so currently it's: USER:ROLE:TYPE:MCS Label.

Let's look at the example of Table 1, where libvirt creates two virtual machines with dynamically generated SELinux labels.

You can obtain the SELinux labels for a running VM process, as follows:

```
# ps -eZ | grep qemu
system_u:system_r:svirt_t:s0:c514,c932
```

You can obtain the SELinux labels for the image, as follows:

```
# ls -lZ /var/lib/libvirt/qemu/images/f12.img
```

```
system_u:object_r:svirt_image_t:s0:c514,c932
```

In the above snippets, take a look at the MCS labels. Here, s0 indicates the 'Sensitivity Level', and c514 as well as c932 indicate the 'category of the data'. Administrators can define these categories.

If you attempt to change the SELinux context (using the `chcon` command) of the VM image file, it will throw up SELinux AVC (Access Vector Cache) denials.

SELinux prevents virtual machine 1 (system_u:system_r:svirt_t:s0:c514,c932) from accessing virtual machine 2's image file (system_u:object_r:svirt_image_t:s0:c101,c230)—the VMs can't access each other's data, either on-disk or in-memory and hence cannot attack each other. **END**

References and acknowledgements

- Daniel Walsh: danwalsh.livejournal.com (sVirt blog posts/presentations/inputs)
- James Morris: <http://blog.namei.org> (sVirt blog posts/presentations/inputs)
- Amit Shah and rest of Red Hat virtualization team: [Review](http://review.svirt.org)
- svirt Wiki: <http://selinuxproject.org/page/SVirt>
- Libvirt Project page: <http://wiki.libvirt.org>

By: Kashyap Chamarthy

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A young man with a wide smile, wearing a black cowboy hat and a light blue denim shirt with a star patch and a 'TRUCKEE' logo, is holding a computer monitor. The background is a dimly lit bar or restaurant with warm lighting and wooden furniture.

Serve Up that Desktop with Some SPICE

Here's a simple protocol that can really add some spice to the growing desktop virtualisation market.

Ask any person from the apparel world and they will all agree that "Fashion repeats itself!" Some will also hasten to add that new designers and manufacturing technology reinvent the earlier forms into styles relevant today. Personally, I feel that the length and breadth of some of the most fashionable garments are taking us back to the Stone Age.

Does this hold true for information technology as well? From the huge mainframes and minis of yesterday to powerful desktops, we seem to be coming back to an era of thin clients. Undoubtedly,

technology innovations have added their spice to this repetitive cycle in the evolution of technology (or so it seems to me).

Instead of a thick, fat, powerful computer sitting in some remote corner, cloud computing and server virtualisation has enabled us to concentrate technical horsepower in the data centre. Virtualisation on the ubiquitous x86 hardware has enabled organisations to optimise their IT rupees on hardware. The advent of TCP/IP, the Internet, and specifically the HTTP protocol and the browser, have enabled more and more software to be delivered as a service over a wide variety of devices.

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Yet, today, even if you check your mail on a smartphone, you get back to your laptop for jobs that can only be done on your desktop/notebook PC. The handheld today is striving hard to be a replacement, but is at best a complement.

Imagine, if you were able to work on your handheld as if it were your PC. If you were at home, you could simply log out of the handheld and log in to the home entertainment laptop. At office, you could work on a thin client and if, by chance, your handheld ran out of battery while travelling, you could continue from where you left off on a friend's handheld or from any other device capable of connecting to your data centre over the Internet.

If the above seems too futuristic, this article is for you. If it sounds stale, maybe the next article will be the one for you. Either way, you cannot escape the promise of desktop virtualisation; my desktop—everywhere, everytime.

But what is this new thing about desktop virtualisation? Have we not been using the remote desktop, VNC and other tools for ages? Have we not logged on to remote PCs and achieved the above? Ask all software developers and they will tell you how difficult it is to work without the ability to install/use their favourite editor/debugger. Ask any office assistant to print simple documents on remote desktops to local printers, or ask a sysadmin to copy a required patch from a local USB pen drive to the remote desktop, and they will tell you it's still not an easy task.

Desktop virtualisation is significantly different from server-based computing and that is why it holds great promise—especially for the BPO and software development (IT and ITes) verticals to begin with. Once the technology matures further, I am sure that it would be the platform of choice for all. Software as a Service (SaaS) might give way to the Desktop as a Service (DaaS).

To quote Wikipedia (en.wikipedia.org/wiki/Desktop_virtualization), "According to a report by Gartner, hosted services accounted for more than 500,000 desktop units as of March 2009, but will grow to 49 million desktop units by 2013, and may make up as much as 40 per cent of the worldwide professional personal computer market, by revenue."

Server-based computing (or SBC) refers to traditional methods of remote access—VNC, rdesktop, etc. Desktop virtualisation has distinct advantages over server-based computing for individual access. Some of these that can be clearly envisaged at this stage of the emerging technology are:

- A user experience similar to the local machine.
- Desktop virtualisation provides access to local audio, USB, etc, providing unparalleled ease of use and flexibility.
- CPU and GPU intensive tasks can be offloaded to the client instead of increasing the load on the central server. A user running a CPU-intensive compilation can slow down the central server for others.
- Complete customisation and freedom—all users can add/remove software, and customise the environment as per their preferences.

Apart from server-based computing, desktop virtualisation

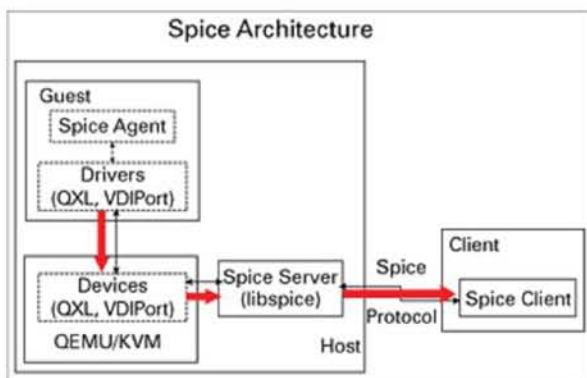


Figure 1: The SPICE architecture

has tremendous benefits over the 'desktop' model as well—one machine per user:

- Freedom from hardware crashes: In case the client hardware crashes, the remote session can be easily accessed from any other device.
- Better security: Again, this is based on the assumption that a data centre is generally more secure in all aspects.
- For a sysadmin, managing hundreds of individual machines versus managing virtual machines translates to ease of patch management and new deployments... the list is endless.

In short, desktop virtualisation is here to stay. It is still early days, but it is undoubtedly the way forward in these times of server virtualisation and cloud infrastructure.

There are already a few products in the market for desktop virtualisation, but it is the open source SPICE technology that holds the key, as far as I am concerned. Preventing vendor lock-ins and based on KVM (stock Linux kernel), it holds interesting prospects. Red Hat has open sourced the SPICE protocol that it acquired from Qumranet into Red Hat Enterprise Virtualisation for Desktops (currently in beta).

SPICE stands for Simple Protocol for Independent Computing Environments. The basic components of SPICE are:

1. The SPICE server
2. The SPICE client
3. The SPICE protocol

In a traditional SBC environment, there are just two layers—the back-end and the front-end. The back-end layer resides on the server host, and the front-end layer on the client. The front-end layer of the software interprets the inputs—the keys' input and mouse movements—and transmits them over to the back-end. The backend layer exposes the graphical display and the front-end layer, typically, plugs into this.

How SPICE operates differently is that the backend layer does not connect directly to the underlying hardware through the operating system. The back-end layer is a hardware emulation layer. The desktop to be logged in is actually a virtualised guest that exposes itself through the Virtual Device Interfaces (VDI), such as a virtual graphics driver, etc.

In the middle of the back-end and the remotely connecting client sits the SPICE server, which now actually becomes the front-end for the virtual devices.

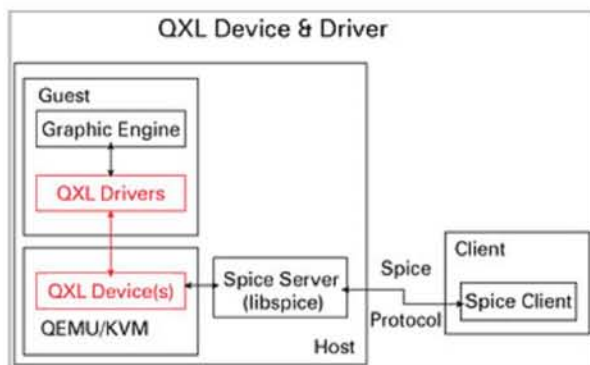


Figure 2: QXL device and driver

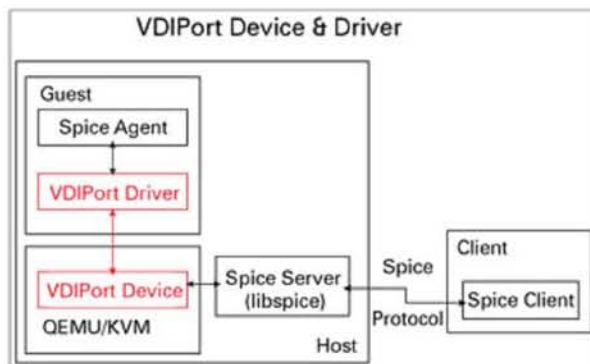


Figure 3: VDI port device and driver

The SPICE server interacts with the remote client (SPICE client) on the outside, while on the inside it interacts with the virtual devices that are exposed to it by QEMU running over KVM. Figure 1 depicts SPICE architecture.


The desktop being accessed from the remote location is actually a virtualised guest that exposes its devices—typically, display, audio and USB—to the SPICE server to connect with. Thus, SPICE will only work when the remote hosts are virtual machines. The remotely connecting client connects to the SPICE server using the SPICE protocol, which communicates events like keyboard and mouse inputs, graphics commands, audio streams, etc.

The advantage of the above is an OS-independent protocol that only needs the SPICE client. You can install the SPICE client and run it using a Web browser like Firefox. Moreover, SPICE is able to achieve great performance when compared to other environments because a virtual GPU (called QXL) has been developed for SPICE to improve its graphical

performance. This supports active display on the remote client from the boot stage—something not possible in traditional SBC environments, since the remote hosts to be connected to have to remain switched on and booted. Red Hat has released QXL PCI drivers for Windows and Linux, though standard VGA is supported if no drivers are available.

The graphics rendering subsystem differs from traditional SBC environments in another significant manner. Most SBC environments send graphical updates to the remote client by updating frame buffers. SPICE supports transmission and handling of 2D graphics commands. SPICE uses Cairo, a 2D graphics, device-independent library and Pixman for manipulating pixel regions (www.cairographics.org), apart from using image compression, video compression and caching to increase the client side display rendering experience.

Another important component in the SPICE scheme of things is the SPICE agent. This resides on the virtualised guest and supports a communication channel between the SPICE client and the agent. Yet another virtual device, the VDI Port—a QEMU PCI device—is used for this communication. This virtual device is used by the client to communicate with the agent. For a virtualised Windows guest, the agent is a Windows service that runs on the guest.

SPICE also has audio and USB support. At a recent demonstration, we used two different clients to connect to the same guest. We played a song on one of the clients (a Linux desktop), logged out of it and connected through a laptop (running Windows) to hear the same song being played. The customer has since evinced a keen interest in deploying SPICE for his office over a WAN link. The demonstration elicited the same “Wow” that I had experienced when I first came across this wonderful technology—a simple protocol that can really add some spice to the growing desktop virtualisation market. Feel free to contact me, in case you have any specific queries about SPICE or its implementation. **END** 

By: Varad Gupta

Varad is an open source enthusiast who strongly believes in the open source collaborative model not only for technology but also for business. India's first RHCSS (Red Hat Certified Security Specialist), he has been involved in spreading open source through Keen & Able Computers Pvt Ltd, an open source systems integration company, and FOSTERING Linux, a FOSS training, education and research training centre. The author can be contacted at varad.gupta@fosteringlinux.com

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The Poor Man's XP Mode



In a perfect world, all software would be free and you could work on whatever system you chose. However, reality is always stranger than fiction, and a certain operating system called Windows, made by Microsoft Corporation, almost always prevents you from switching to GNU/Linux.

A bewildering majority of Linux users dual-boot between Linux and Windows. There are many reasons for this, the most common of which is corporate software. Almost all major companies use custom software, which typically run only on Windows. Another major cause is that Microsoft refuses to take any action against those who use 'unlicensed' and 'non-legitimate' copies of Windows. The fact of the matter is, Windows is here to stay (at least for a while), and there's nothing that can be done about it.

Of all the versions of Windows, Windows XP is still the preferred one for most of the world's population. No other OS can run as many applications as XP. Windows Vista was a disaster partly because it couldn't run a lot of older apps. In fact, rather than beef up compatibility, Windows 7 launched something called XP Mode for all its enterprise and 'enthusiast' versions—Windows 7 Professional and Ultimate.

As Microsoft states, it had no choice because the immensely long shelf life of Windows XP

enabled a huge amount of software to be developed for it, most of which is incompatible with the current Windows NT 6 architecture. Microsoft has made sure XP Mode is available only for the enterprise versions—for offices running corporate software that are incompatible with NT6. However, the idea behind XP Mode is not novel—it's being put to good use in many other places.

XP Mode: What is it?

In its most basic form, XP Mode is a para-virtualised, fully licensed copy of Windows XP Professional with Service Pack 3 running on Windows 7. With hardware-assisted virtualisation becoming available to the masses via AMD-V and Intel VT-x, a para-virtualised Windows XP makes perfect sense. At the cost of only a 15 per cent performance drop compared to the native performance, the latest version of Windows is able to run all the apps that could run on Windows XP.

However, XP Mode isn't available for everyone. Windows 7 Home Premium

customers, for example, are left out in the cold.

Take the case of my father. He uses Windows Vista Home Premium because he's a power user, but doesn't require all the power of Windows Vista Ultimate. Fortunately for him, all his software work on Vista. But suppose they did not? He'd have had to fork out over Rs 13,000 for Windows 7 Ultimate, now that Windows XP isn't available on the retail shelves. Considering he already has a licence for Windows XP Professional as well, that would have been a huge loss. He might as well ditch Windows 7's better user experience and install Windows XP. Either way, getting XP Mode working requires giving Microsoft quite a bit of money.

Enter, the poor man's XP Mode

In the best case scenario, you use Linux but do have to use Windows for some corporate software (your need could even be as trivial as running your smartphone's PC suite-like software). If you have a licence for Windows XP, it means that you can get XP Mode for free, and cut the hassle of rebooting every time you need to use Windows. As an added advantage, the poor man's XP Mode works on Windows, Mac, OpenSolaris, Linux and even BSDs. And it has the best price one can ask for: it's free!

What can this provide?

- A virtualised copy of Windows XP that can run all your corporate apps, sync your cell phones, run some games (NOT Crysis Warhead; so if you're a serious gamer, don't even think about this) and some niche software, such as desktop publishing and designing software, non-linear video editors and more.
- A seamless environment, where the Windows apps look like they're on the Linux desktop.
- Copy-and-paste between the Linux and the Windows apps.
- File sharing between Linux and Windows—for both read and write
- Accelerated DirectX on the Windows XP desktop.
- All available for Mac, Windows, Linux, OpenSolaris and even BSD. Time to take revenge on Microsoft by making your XP Mode in Windows 7 Starter Edition ;-)

Happy? As for the requirements for this sort of a set-up, here's the list:

- A legitimate copy of Windows XP (Yes, although that 9-in-1 edition of Windows XP that you bought for 50 rupees from that CD-walla at the train station will do fine, the whole point of this article is to have a solution that's completely legal.)
 - Sun xVM VirtualBox, PUEL Edition.
 - About 10GB of hard disk space to spare.
- Assuming you are ready, let's do it!

Step 1: Installing VirtualBox

Sun xVM VirtualBox is a free, partially open source virtual machine software. Here I'll set it up on openSUSE 11.2.

Basically, you need to head to the VirtualBox website (virtualbox.org), where you'll see self-contained packages for almost all major Linux distros, plus a generic package for any that's not listed. It's just a matter of downloading these

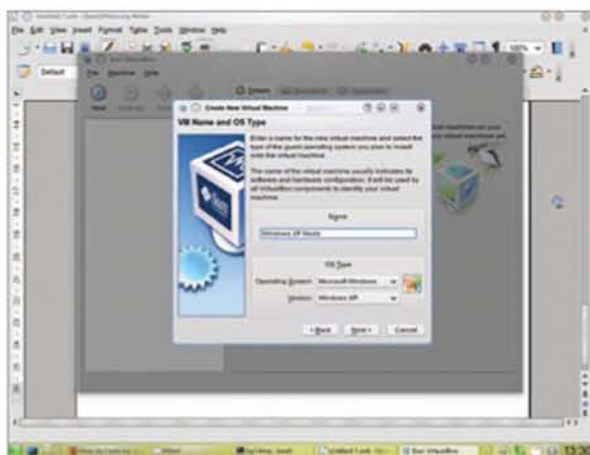


Figure 1: Creating our XP Mode

packages and double-clicking them to install VirtualBox. You will need to have Qt4 installed, and you must remove the *virtualbox-ose* package if it's installed. Also, it's a good idea to have the Linux kernel sources, GCC, and Make installed.

Having come this far, it's time to add your user name to the *vboxusers* group, so that you get access to the USB system in Windows XP. To do this, open a terminal, and type the following command as the root:

```
usermod -A vboxusers <your username>
```

Depending on whether your distro is hit by this bug or not (openSUSE is), if nothing happens when you start VBox, type in the following:

```
chmod +x /usr/lib/virtualbox/VirtualBox
```

We are now done with this step. So let's create the machine that will run Windows XP.

Step 2: Creating the virtual machine

To open VirtualBox, head to your System Tools group under your applications menu. The first time you start this app, you'll be asked to register it. If you have a Sun Developer Network account (or a Project Kenai ID), then just enter your e-mail and password. Otherwise, you'll have to fill in details about yourself. You can also click *Cancel* and continue, but it's generally a good idea to register your copy.

Now, on the top toolbar, hit *New*. The *Create New Virtual Machine Wizard* will start. Hit *Next*. Now give a name to this virtual machine (as shown in Figure 1), and leave the OS as Windows XP (or Windows XP 64bit if you have a 64bit Windows XP). Click *Next*.

You need to devote some memory to this machine. I have 2 GB of RAM, plus 4 GB of swap space, so I'm going to give XP Mode 1 GB of RAM. If you have the dream 4 GB of RAM, then you'd like to give XP 2 GB, though 1 GB is enough, as XP rarely requires more than 300 MB by itself. Once you are done, click *Next*.

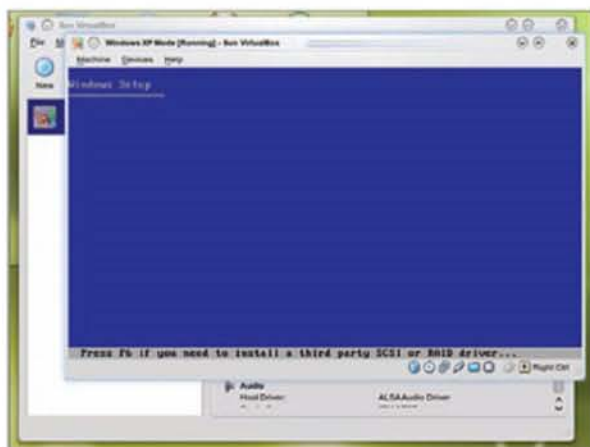


Figure 2: Time to install SATA drivers



Figure 3: This is our XP Mode

In this screen, make sure **Boot Hard Disk (Primary Master)** is checked; then select **Create New Hard Disk** and click **Next** and again **Next**. Here, you should choose **Fixed Size Disk** for optimum performance, but a **Dynamically Allocated** one will do, too. A fixed-size disk will have all the hard disk space allocated at the beginning, while a dynamically allocated one will keep on expanding the disk size as the data grows in size. After making your selection, hit **Next**. Make sure the size is at least 10 GB, and then hit **Next** and finally **Finish**. Again, at the summary screen, hit **Finish**. We have just created the Virtual Machine. Now it's time to fine-tune it.

Make sure the Windows XP VM is selected, and hit the **Settings** button on the toolbar of VirtualBox. Move to the **System** section, and enable the checkbox for **IO APIC**. Move to the **Processor** tab and enable **PAE/NX** to make the **Execute Disable Bit** feature available for Windows. Also, if your CPU supports **AMD-V** or **Intel VT-x** (hardware-assisted virtualisation), you will be able to increase the number of virtual CPUs available for the use of the VM. It's a good idea to use half the physical number of cores—so on a dual core you would use one processor; on a quad core make it two. On my triple core, I'm using two processors since the host is Linux, but on a

Windows host this is not viable due to the performance penalty (the penalty, for some strange reason is Windows-only). Move to the **Acceleration** tab, and enable all the available features. The ones that are not available are greyed out. **VT-x** or **AMD-V** is the basic hardware-assist technology, and nested paging gives another huge performance boost.

Now move to the **Display** section and increase the **VRAM** to at least 64 MB. Also, enable **3D Acceleration**. Note that the **VRAM** is deducted from your graphics card memory (I'm endowed with 1 GB of it), so there's no penalty on available RAM. However, if all you have is an old Intel 865GV graphics card with 64 MB of **VRAM**, you'll have to make do with 12 MB of **VRAM** for the VM and no 3D acceleration. Once done, move on to the **Hard Disks** section.

Here, enable the checkbox for **Enable Additional Controller** and select **SATA (AHCI)**. In the attachments section, change the **HDD slot** from **IDE Primary Master** to **SATA Port 0**. Move to the **CD/DVD-ROM** section and enable the checkbox for **Mount CD/DVD Drive**. You may enable **Pass Through** if you want to write CDs in Windows, but at the moment, writing audio CDs is not possible and the host may behave in a bizarre manner.

Now move to the floppy section. Here comes the tricky part.

We enabled the **SATA** controller just now, as like the real thing, virtual **SATA** is a bit faster and less costly on the host to virtualise. However, Windows XP does not recognise any hard drives attached to the **SATA** controller, because it does not have the drivers. Therefore, Windows Setup exits with a 'No hard disks found' error. The solution is to use a floppy image loaded with the Intel Matrix Storage Technology **SATA** drivers (since the **SATA** controller is an Intel ICH8 chipset). Make sure the **unzip** command is installed, and then head to <http://tinyurl.com/matrix-drivers> to download the **f6flpy32.zip** file. Once it's downloaded, open a terminal and type in the following commands:

```
unzip f6flpy32.zip
unzip f6flpy32.exe
```

The **EXE** file is contained in the **ZIP** file and is another self-extracting **ZIP** file. Extracting it gives the file **F32.IMA**. This is a Windows Setup Driver Disk, which provides drivers to the initial Windows Setup to install Windows XP. Copy this file somewhere safe.

Now come back to VirtualBox. Check the **Mount Floppy Drive** checkbox, select **Image File** and click the folder icon beside it to launch the Virtual Media Manager. Hit **Add**, and then browse to the **F32.IMA** file (you'll have to change the **Files Of Type** to **All Files** to see the file). Hit **Select**. Now that this step is done, move to the **Shared Folders** section.

Here, you can specify a folder that will be accessible as a network share to Windows. This share can be mapped to a network drive, and you can use it as a storage drive. I find giving it access to the 'Public' directory in my home best serves this purpose. To do this, click the **Add Share** button (the blue folder with the **Plus** icon), and then on the **Folder Path** field browse to your 'Public' directory. The machine is now fully configured! It's time to install Windows XP.

Step 3: Installing Windows XP

Insert the Windows XP CD into the CD ROM drive and start the Virtual Machine. Wait for Windows Setup to start. As soon as the blue screen appears, check the grey bar at the bottom when it asks you to press F6. As soon as it does (Figure 2), press F6. Nothing may seem to happen at first, but eventually a screen will appear, asking for a *Driver Disk*. Press S here.

Now a listing of the drivers on the floppy disk will appear. Select the "Intel(R) 82801HEM/HBM SATA AHCI Controller (Mobile ICH8M-E/M)" driver, the second on the list. Press Enter twice. Now the Windows Setup program will start. I'm not going to guide you on how to install XP here—if you aren't sure, google for the relevant how-to article.

Once the installation finishes and you've rebooted to start XP (Figure 3), it's now time to configure it!

Step 4: Configuring Windows XP

First of all, *update your copy of Windows*. Install the latest Service Pack (which is Service Pack 3), all the hotfixes, Internet Explorer 8, Windows Media Player 11, .NET Frameworks 1.1 through 3.5 and Sun Java. This makes sure you are protected against all security flaws.

Now it's time to install the VirtualBox Guest Additions. From the *Devices* menu in VirtualBox, click *Install Guest Additions*. Follow the wizard (Figure 4), choose to install Direct3D Support when prompted, and reboot at the end of it all. Once it's done and Windows has started up again, go to the *Machine* menu. Prepare to be amazed. Select *Seamless Mode*.

It might take some time to get used to this. The Windows desktop disappears, and the Windows taskbar sits right on top of the KDE4 or GNOME panel. If you are doing this in KDE, it's best to give it its own Virtual Desktop, where there are no widgets. You will truly love this. Windows applications now look like they are part of the Linux desktop, except for a strange theme and window borders. Refer to Figure 5.

However, *Seamless Mode* does have some limitations, and there are haphazard renderings at times which look like screen corruption. Also, moving windows around the desktop becomes kind of slow, but it really does not annoy. There may be times you'd want to switch to plain old fullscreen mode, but this can be rather buggy. For example, on pressing HostKey+L, the VirtualBox window may just not appear. The only option then would be to switch back to seamless mode by pressing HostKey+L and then rebooting Windows.

The next bit involves all those shared folders. Right-click *My Computer* on the Windows Start Menu, and choose *Map Network Drive*. On the dialogue box that appears, select a *Drive letter*, and in the *Share path* field, type in `\\VBOXSVR\<Share Name>`. For example, if the share name is 'Public', enter the share path as `\\VBOXSVR\Public`. Now, in *My Computer*, you can access all your shared folders as Drives.

That does it. Our Windows XP Mode is complete. Fire it up, work on it, run all your Windows-only apps with maximum compatibility, share data between the host and guest OS, copy and paste between the two with Shared Clipboards, even do some light gaming. But of course, if you expect it to

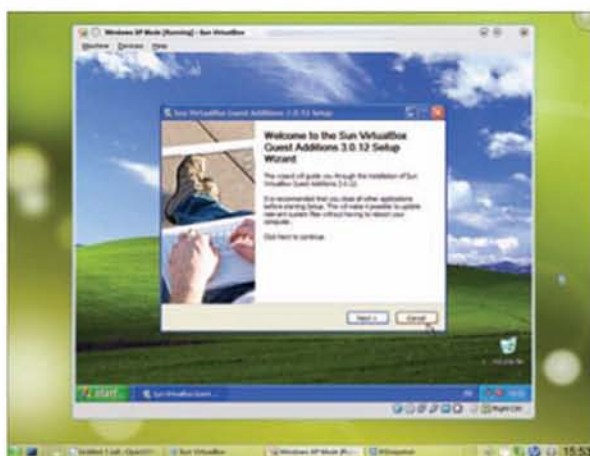


Figure 4: Installing VirtualBox Guest Additions

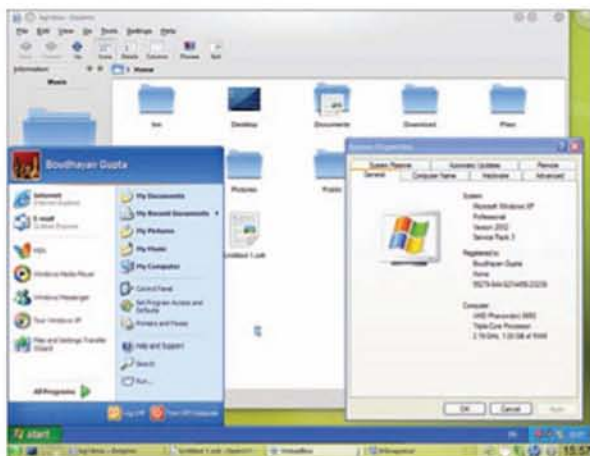



Figure 5: Running XP in 'Seamless Mode'

run Crysis at 1920x1080 and 200FPS, with all settings turned to *Max*, I'm afraid it's asking a bit too much...

The bottom line

Since VirtualBox is cross-platform, you can use it to virtualise XP on Windows 7 as well. If you are adventurous enough, try virtualising Linux on Windows. The installation is easy, but integrating Linux into Windows is not. But if you can do it, you will truly love the results.

Finally, your mileage may vary. **END** 

Since the time the article was written, a new version of VirtualBox has been released which changes the UI in the *Settings* dialog quite a bit. Under the *Storage* section, the configuration is done via a "Storage Tree", where you need to create controllers (IDE, SCSI, SATA and Floppy), and then add devices to it (such as physical drives, ISOs, etc). Everything else remains more or less the same, and the new UI is very self-explanatory.

By: Boudhayan Gupta

The author is a 15-year-old student studying in Class 9. He is a logician (as opposed to a magician), a great supporter of Free Software and loves hacking Linux. Other than that, he is an experienced programmer in BASIC and can also program in C++, Python and Assembly (NASM Syntax).



Niyam Bhushan

Ring the Liberty Bell

Declare your freedom from enslaved music.



services, and music publishers. Sadly, in India, most musicians and lyricists get almost nothing from this, as they often have to sign away their copyrights and ownership over their

authored works to a film-producer or music company.

A call to freedom

Here's my rose-tinted vision of FOSS-based flower-power for such enslaved music. It's obvious the software to enable all this magic is locked away from the hands of end-users and geeks. So the four freedoms of GNU need to be applied to such software. Then, anyone, anywhere can set up their own CRBT servers and services, with any music they like – without being restricted by the limited offerings of existing providers. Anyone could then

share this music and service with their friends and communities. More obviously, software could be written to run directly off handsets, to set any existing music file on memory-cards as the CRBT for any caller, so anyone, anywhere could download any CRBT as a music file to their handsets.

You love freedom. You love sharing ideas, books and music with your friends. You've emancipated your computers from the claustrophobic coils of Microsoft's code and swear by copyleft, Linux, and all things *muft* and *mukt*. Logos and messages on your t-shirts paint you into a tribal warrior of our digital age. You proudly demo your phone with pre-installed Android or any other free and open source OS. Then I call your number. And all I hear is the iron-clang of a prison-gate in a dungeon, clamping shut.

Wring that tone

I am talking about the Caller Ring Back Tune (CRBT) that people have to endure, when they call you. Airtel for instance, markets this in India as 'Hello Tunes'. The irony of the situation is that on one hand, you haven't bought a single audio CD for years, in defiance against the music industry's anti-customer practices, and to rebel against the high price of Rs 100 to 400 per CD. You prefer instead to source music tracks accompanied by all the excitement and adventure of digital discovery. On the other hand, you're unwittingly playing right into the claws of the other powers-that-be when you activate CRBTs on your hand-phone.


As a typical example, you're paying Rs 15 to select a track, and then an additional Rs 30 per month to 'subscribe' to the service. That's Rs 375 per year. If you change the tune every month or week, or have different tunes set up for different users, add Rs 15 for each instance. So, whether it's Rs 375 or more than Rs 540 per annum, that is a lot of money to pay for a single track of music, which is not even physically in your possession or stored as a file on your handset. Heck! For all that money, you don't even get to listen to it yourself. Any caller to your number listens to only a few seconds of tinny-sounding music streaming into one ear.

Won and zero

Now zoom out to the bigger picture here. According to widely-published industry reports, India has nearly 500 million mobile phone users. So hypothetically, even if 10 per cent pay for some form of music subscriptions, that's about Rs 18 billion, or Rs 1,875 crore per annum. The actual user-base and revenue could be significantly higher. This services fee is distributed in three uneven chunks between mobile-service providers, outsourced companies providing such value-added-

"That is a lot of money to pay for a single track of music, which is not even physically in your possession."

Free enterprise

Such freedom also entails the freedom to generate wealth out of *muft*-and-*mukt* software and services. Markets would be prised open from monopolies and cartels worldwide. The rules of free market enterprise would come into play. And this change can happen now. For instance, in a market crowded by mobile operators, sooner or later, a few will hit upon this idea to capture market share. Music services like Magnatune, and music published under Creative Commons licences could soon create their own buzzing communities that provide free music to mobile-users from Philadelphia to Phagwara and anywhere else in the world. These are interesting times, with the vision of Linux and FOSS extended to completely new paradigms of the new intangible economy of this century. Stay tuned for more bold ideas in the next column. **END** 

About Niyam

Inspired by the vision of Osho. Copyright February 2010: Niyam Bhushan. freedomyugs@gmail.com. First published in *LINUX For You* magazine. Verbatim copying, publishing and distribution of this article is encouraged in any language and medium, so long as this copyright notice is preserved. In Hindi, 'muft' means 'free-of-cost', and 'mukt' means 'with freedom'.



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DJANGO

When Python Bites the Web



Here's how to start using Django for Web application development.

Quoting Wikipedia, “software frameworks aim to facilitate software development by allowing designers and programmers to devote their time to meeting software requirements rather than dealing with the more standard low-level details of providing a working system, thereby reducing overall development time.”

Rails is one of the most famous Web application development frameworks on top of the Ruby programming language. Django, on the other hand, is an advanced Web programming framework built on top of Python. Django is a strong competitor of Ruby on Rails.

Django abstracts lots of background details, like the SQL database, by providing higher-level interfaces. It is a very handy framework and a quick solution to build any complex Web application. If you are already familiar with the Python programming language, you would find it easy to hack with Django.

Let us get started

We will now look at how to get started with Django. You need the Django development server to work with it. Download the development server from www.djangoproject.com.

and install it as follows:

```
$ wget http://www.djangoproject.com/download/1.1.1/tarball/
$ tar xzvf Django-1.1.1.tar.gz
$ cd Django-1.1.1
$ sudo python setup.py install
```

...or on Ubuntu:

```
$ sudo apt-get install python-django
```

On installation, certain Django utilities like *django-admin* and *manage.py* will be available. We will use these tools throughout the development process.

Now let us dig into the basics. A Django project is an environment where we deploy the Django server. A Django project may contain more than one application. Here, there are Django Web applications that are sub-grouped as different modules. You will understand the distinction between a Django project and application in detail when we look at the code.

You can create a new Django project using the *django-admin* command:

```
$ lynux@hackbox:~/LFYS $ django-admin startproject helloworld
$ lynux@hackbox:~/LFYS $ cd helloworld/
```



```
slynux@hackbox:~/LFY/helloweb$ ls
__init__.py  manage.py  settings.py  urls.py
```

A directory named *helloweb/*, which is the name given to the project in the above snippet, will be created. The directory will contain the basic skeleton for a Django project. Figure 1 shows the directory skeleton structure.

You will find the *__init__.py* file in most of the directories in a Django project. Its purpose is to mark the directories on a disk as Python package directories, to be imported by Python in the program.

For example, if we have a directory *foo/* and it contains the files *__init__.py* and *linux.py*, we can access its contents from a Python shell as follows:

```
>>> from foo import linux
```

The *manage.py* file is the project management file. We will execute this file to do further management tasks related to the current project after the basic skeleton is created. We will use *manage.py* to start the development server, create new applications, synchronise database tables and do many other things inside the project directory in which *manage.py* exists.

The *settings.py* file holds the different settings variables for the current Django project. It includes the time zone used, database authentication and connectivity, templates, additional Django extensions support, etc. It manages the overall settings for the project.

The *urls.py* file is the URL map file for the current Django project. In *urls.py*, we will add different URL mapping schemes. When we request some URL, the function of this file is to specify what should be displayed as the output. It has a pretty good regex support, and many customisation options. It directs each URL to a view function, which returns the output HTTP response.

If some non-existent URL is requested, we can direct it to a custom '404 Error' page. Or if we request a URL in the format of *http://example.com/page/(digits)/* (for example, *http://example.com/page/11/*), we can write custom regular expression patterns such that this Web page will always be handled by a custom-written page function and the *(digits)* will be taken as the parameter.

Now, let's look at how to set up a basic Django HelloWorld application.

We'll use the Django development server to test our Web application. After development, we will deploy it on an Apache server with Django extension support.

Navigate to the project skeleton directory that we have created and issue the following command:

```
slynux@hackbox:~/LFY/helloweb$ ./manage.py runserver
Validating models...
0 errors found
Django version 1.1.1, using settings 'helloweb.settings'
Development server is running at http://127.0.0.1:8000/
Quit the server with CONTROL-C.
```



Figure 1: Directory structure of the 'helloweb' Django project

The above snippet informs us that a development server has started and we can access the output pages from the local host machine by pointing a Web browser to the following URL: *http://127.0.0.1:8000/*. By default, the development server runs at port 8000. We can change it by using the desired port number as an additional argument along with the *manage.py* command as follows:

```
slynux@hackbox:~/LFY/helloweb$ ./manage.py runserver port_no
```

Shell

There is an option provided by *manage.py*—the Django *shell*. We can use it to access the Django Python interpreter (which runs the current project's Python interpreter with its environment set-up). It is very helpful during the debugging process:

```
slynux@hackbox:~/LFY/helloweb$ ./manage.py shell
Python 2.6.4rc2 (r264rc2:75497, Oct 20 2009, 02:55:11)
[GCC 4.4.1] on linux2
Type "help", "copyright", "credits" or "license" for more information.
(InteractiveConsole)
>>>
```

We need to write a sample Web page using Django now. Create a file *views.py* and append the following lines in it:

```
from django.http import HttpResponseRedirect
def index(request):
    html = "<h1>Hello Web !</h1>"
    return HttpResponseRedirect(html)
```

The above snippet of code is known as a 'view'. Views generate the HTML data for the Web page:

We need to set up the *urls.py* next. Add the following line to *urls.py*:

```
(r'^helloweb/$', 'helloweb.views.index'),
```

...so that it looks like the following code:

```
from django.conf.urls.defaults import *
urlpatterns = patterns('',
    (r'^helloweb/$', 'helloweb.views.index'),
)
```

Now, using a browser, check out the following Web page: *http://localhost:8000/helloweb*. You can see the output returned by the *index()* function.

Project settings

The *settings.py* file handles the overall settings for the current Django project. Let's take a look at the basic file structure. Here, I will only explain the important sections in this file. It is much easier to comprehend other options since they are self-explanatory, thanks to the excellent commenting:

```
slynn@hackbox:~/LFY/helloweb$ less settings.py:
DATABASE_ENGINE = ''      # 'postgresql_psycopg2', 'postgresql', 'mysql',
                          # 'sqlite3' or 'oracle'.
DATABASE_NAME = ''       # Or path to database file if using sqlite3.
DATABASE_USER = ''       # Not used with sqlite3.
DATABASE_PASSWORD = ''   # Not used with sqlite3.
DATABASE_HOST = ''       # Set to empty string for localhost.
                          # Not used with sqlite3.
DATABASE_PORT = ''       # Set to empty string for default.
                          # Not used with sqlite3.
```

This section is used to provide the database settings. In Django, we use the models concept to deal with the database and datamodels. It supports all the various database servers that are widely used. To use a MySQL server, we can configure the settings as follows:

```
DATABASE_ENGINE = 'mysql'
DATABASE_NAME = 'database_name'
DATABASE_USER = 'database_username'
DATABASE_PASSWORD = 'password'
```

We may use CSS and JS files as resource files for our Web page. In order to reference them we need to provide the absolute path and the media URL path. For example:

```
MEDIA_ROOT = '/home/slynn/LFY/helloweb/media'
MEDIA_URL = 'http://localhost:8000/helloweb/media'
```

We'll need to specify the *MEDIA_URL* parameter in the URL format that points to the absolute path. We will use the *MEDIA_URL* to access media files like CSS, JS and other files accessible throughout the Web URL.

To facilitate template support, we use template settings in the *settings.py* file. We specify the templates directory path using the *TEMPLATE_DIRS* tuple as follows:

```
TEMPLATE_DIRS = (
    '/home/slynn/LFY/helloweb/templates_dir1',
    '/home/slynn/LFY/helloweb/templates_dir2'
)
```

The *INSTALLED_APPS* section facilitates using third-party Django modules along with our project. For example, if we need a user registration application, we need not write it from scratch. We can download it and attach that application to our project by keeping the application in our project directory and adding a line in the *INSTALLED_APPS* tuple. When we add some applications to the current project, we have to add its reference path to this tuple:

```
INSTALLED_APPS = (
    'django.contrib.auth',
    'django.contrib.contenttypes',
    'django.contrib.sessions',
    'django.contrib.sites',
)
```

Views and templates

Writing dynamic pages in Django is very easy. Django puts different concepts into practice—like views and templates.

Views are routines that actually return an output as a Web page, i.e., a dynamic page. We can keep several view routines for different URLs. When a URL is requested by a browser, the Django server checks its mapping from the *urls.py* file, and the corresponding function specified in it is displayed as the output.

Templates in Django are similar to what we mean by templates, in general. The basic idea is to keep the HTML user interface code separate from the logic code and data processing side. Templates provide a higher abstraction over the logic. We can use the variables and data that are returned by the core functions as required by the user interface part. Thus we can simply write the user interface code without bothering about the core logic.

We will now look at how to write view functions in practice. We can place our views in any custom *.py* file. But we have to specify its path in the *urls.py* URL configuration file.

Consider the following code fragment:

```
from django.http import HttpResponse
def index(request):
    return HttpResponse("Hello World")
```

This is the simplest form of the view function.

To map a URL to a view function, we need to append the following line to it:

```
(r'^helloweb/$', 'helloweb.views.index'),
```

Here, *r'^helloweb\$'* is the URL regular expression; the *^* symbol specifies that the page URL starts with *helloweb*, and *\$* specifies that the URL ends with *helloweb*. Hence, the URL is matched to the *index()* function only when a correct 'helloweb' occurs in the URL.

If the regular expression was just *r'helloweb'*, it can match any URL, like *something_helloweb_something*.

The 'request' parameter in a view function is the *HttpRequest* object. We can obtain data related to a session, GET request, and POST request from the 'request' object.

To obtain POST request variables, we can use *post_var = request.POST*. It will return a dictionary that contains all post variables and their values. We can use *get_var = request.GET* to obtain all GET variables and values. Similarly, for a Session, use *session_var = request.session*.

To check whether a variable exists in a dictionary, we can make use of the *has_key()* method. Have a look at the modified index view function that makes use of GET variables:


```
def index(request):
    html = "Hello world, No page requested"
    if request.GET.has_key('page_no'):
        html = "Hello World, Page requested is no: %s" % request.GET['page_no']
    return HttpResponse(html)
```

Now the page responds according to the GET request variable, `page_no`. Try different URLs—for example, `http://127.0.0.1:8000/helloweb/?page_id=100` and `http://127.0.0.1:8000/helloweb/`

We will now look at how to handle `page/15/-type` URL mapping to views—for example, `http://127.0.0.1:8000/helloweb/page/44/`. Peeking inside the `urls.py` file, we have:

```
urlpatterns = patterns('',
    (r'^helloweb/page/(?P<page_id>\d+)/$', 'helloweb.views.page'),
)
```

The view function in `views.py`:

```
def page(request, page_id):
    return HttpResponse("This is Page: %s" % page_id)
```

Here, `(?P<page_id>\d+)` is the regular expression technique used: `\d+` defines the type of data, i.e., the digits; and `<page_id>` defines the name of the variable, so that we can use it as an argument for the view function page.

The view function can parse the page number from the URL and set `page_id=number`, so that we can manipulate the output `HttpResponse` according to that page number.

Here we have discussed a simple `HttpResponse`, which always returns HTML code given as an argument. Now we will look at how to deal with templates.

From now, we will place the HTML code as separate `.html` files, instead of inside the view function—and we call them as templates. Set the templates directory in `settings.py`:

```
TEMPLATE_DIRS = (
    "/home/slynux/LFY/helloweb/html_templates"
)
```

Create an HTML file in the `html_templates/` directory called `template1.html`, with the following content:

```
<html>
<head><title> Django Hello Web project</title></head>
<body>
<p> This is a helloweb template</p>
<table>
<tr><td>Student </td><td>Roll No</td></tr>
<tr><td>S1</td><td>1</td></tr>
<tr><td>S2 </td><td>2</td></tr>
<tr><td>S3 </td><td>3</td></tr>
</table>
</body>
</html>
```

Now we can modify the view function to support the templates. The HTML interface code is taken through a `get_template` function. Here, `Context()` has a dictionary argument. It takes the variables and objects to be passed to the template to generate dynamic code. However, no objects are passed to the template—the template is just a static HTML page:

```
def index(request):
    from django.template.loader import get_template
    from django.template import Context
    site_template = get_template('template1.html')
    html = site_template.render(Context({}))
    return HttpResponse(html)
```

Or we can write the same template rendering in one line using the `render_to_response` shortcut as follows:

```
def index(request):
    from django.shortcuts import render_to_response
    return render_to_response('template1.html', {})
```

We will receive an output like what's shown below:

This is a helloweb template

Student	Roll No
S1	1
S2	2
S3	3

This is purely static. Now we will write a dynamic page utilising the facilities of the Django template system. Change the table section of `template1.html` to the following:

```
<table>
<tr><td>Student </td><td>Roll No</td></tr>
<% for name,rollno in student_list.items %>
<tr><td>{{name}}</td><td>{{rollno}}</td></tr>
<% endfor %>
</table>
also add the following code just above the <table>
<p><% if flag %>
    Flag is on.
<% else %>
    Flag is off.
<% endif %>
</p>
```

...and the new view function to:

```
def index(request):
    from django.shortcuts import render_to_response
    flag=False
    if request.GET.has_key('flag'):
        flag=True
    student_list = {'S1':1, 'S2':2, 'S3':3, 'S4':4}
    return render_to_response('template1.html',{'student_list':student_list, 'flag':flag})
```

...where:

- `{'student_list':student_list, 'flag':flag}` is the argument we have passed to the template file.
- The `flag` variable becomes true for URL `http://127.0.0.1:8000/helloweb/?flag` and false for `http://127.0.0.1:8000/helloweb/`.
- `{% if flag %}` is a conditional block that returns the code part by checking the Boolean value of the flag variable passed to the template.
- A `{% for name,rollno in student_list.items %}` statement is used to derive rows for the table from the data passed as the dictionary to the template file. This is the same as the Python statement: `for key,val in dictionary.item()`
Check out the following URLs, `http://127.0.0.1:8000/helloweb/?flag` and `http://127.0.0.1:8000/helloweb/` and see how they work.

Like the above template techniques, there are lots of options facilitated by the Django template system. The best place to look for more about Django templates is the code example from the Django documentation website at <http://docs.djangoproject.com/en/dev/ref/templates/builtins/>

Databases and models

Django is designed to work with different database management systems. It provides a nice interface to interact with the database- and storage-related tasks. Django does not use traditional SQL queries to interact with the database, like most of the other Web programming frameworks. It introduces a new concept called Models.

In Django, we do not need to work with any SQL queries; the data model concept introduced by Django makes it possible to handle data in terms of objects and groups. Therefore, we have the option of object-oriented database manipulation and management through Django. We manipulate every piece of data in terms of objects.

Let's go through a simple example on how to write a Web page that deals with the MySQL database. Create a database `helloweb_db`, using MySQL or phpmyadmin, with the user name `helloweb` and password `hellowebpass`.

To run applications involving MySQL access, make sure that the `mysql-server` and `python-mysqldb` packages are already installed. Modify `settings.py` with the MySQL database details as explained in the earlier part of this article.

Django can only handle one project at a time. But it can execute many applications. Applications are sub-modules of the Django project. While deploying the Web server, we set the Web root directory to a Django project. We access all other Django applications related to that project by postfixing a path to the Web root URL.

Now we will create a Django application to learn how to code database interactive pages.

```
slynux@hackbox:~/LFY/helloweb$ ./manage.py startapp student
slynux@hackbox:~/LFY/helloweb$ cd student
```

Now the skeleton files for the application `book` appear in

the `book/` directory. There will be a `models.py` file. Write the following code in it:

```
from django.db import models

class StudentRegister(models.Model):
    name= models.CharField(max_length=30)
    guardian_name= models.CharField(max_length=30)
    rollno = models.IntegerField()
    admission_date = models.DateTimeField()
```

We now need to add the reference to the application we created to the `INSTALLED_APPS` tuple of the `settings.py` file—i.e., add the entry `helloweb.student` to the tuple.

To create the corresponding tables automatically in the database, issue the following command:

```
slynux@hackbox:~/LFY/helloweb$ ./manage.py syncdb
Creating table auth_permission
Creating table auth_group
Creating table auth_user
Creating table auth_message
Creating table django_content_type
Creating table django_session
Creating table django_site
Creating table student_studentregister
```

You just installed Django's auth system, which means you don't have any superusers defined.

Would you like to create one now? (yes/no): yes

Username (leave blank to use 'slynux'):

E-mail address: slynux@slynux.com

Password:

Password (again):

Superuser created successfully.

Installing index for auth.Permission model

Installing index for auth.Message model

You can see that besides the `student_studentregister` tables, so many other tables are also created. These are actually for the user administration option provided by Django. For every standard Web application, there will be an administration page. If you have used any content management system like Drupal, you would have seen some kind of administration page that can handle many users, the database contents, etc. Django has a nice feature — by default, it comes with basic data model administration. We can customise this to handle many users and add additional features. You can learn more about the administration interface at <http://docs.djangoproject.com/en/dev/intro/tutorial02/#activate-the-admin-site>.

You can view the SQL code used by Django internally to create tables by issuing the following command:

```
slynux@hackbox:~/LFY/helloweb$ ./manage.py sql student
BEGIN;
CREATE TABLE 'student_studentregister' {
```



```
'id' integer AUTO_INCREMENT NOT NULL PRIMARY KEY,
'name' varchar(30) NOT NULL,
'guardian_name' varchar(30) NOT NULL,
'rollno' integer NOT NULL,
'admission_date' datetime NOT NULL
)
;
COMMIT;
```

Since the tables are already created by `syncdb`, we can work on the data storage using data model objects. For debugging and learning purposes, we can make use of the Django shell interpreter:

```
slinux@hackbox:~/LFY/helloweb$ ./manage.py shell
Python 2.6.4rc2 (r264rc2:75497, Oct 20 2009, 02:55:11)
[GCC 4.4.1] on linux2
Type "help", "copyright", "credits" or "license" for more information.
(InteractiveConsole)
>>> from helloweb.student.models import StudentRegister
>>> student_object = StudentRegister()
>>> student_object.name = "S1"
>>> student_object.guardian_name = "G1"
>>> student_object.rollno = 1
>>> student_object.admission_date = '2009-11-01'
>>> student_object.save()
Now the object instance is saved in the table.
You can retrieve the object instances for StudentRegister data
model as the following.
>>> StudentRegister.objects.all()
[<StudentRegister: StudentRegister object>]
It returns a list of all instances of StudentRegister class.

If you need to get the object instance for a particular data
entry such that rollno=4,
>>> s = StudentRegister.objects.get(rollno=4)
If you need to remove it from database table,
>>> s.delete()
```

We will now modify the templates and views to support database interaction.

Add some more entries to the table by using `student_object = StudentRegister()` and save it using the `student_object.save()` method.


Replace the `student_list = {'S1':1, 'S2':2, 'S3':3, 'S4':4}` line in the view function with the following code that grabs data from the database.

```
from helloweb.student.models import StudentRegister
slist = StudentRegister.objects.all()
student_list = {}
for s in slist:
    student_list[s.name] = s.rollno
```

This will make it populate the `student_list` dictionary with entries from the database/`StudentRegister` instances.

Run the development Web server and see the output. You can see that the table is populated with data from the database. It would be the same data you have fed through the Django shell interface.

Finally, here is a task for you: Modify the template file and the view function `index()` to view all the data from the `StudentRegister` instances—i.e., the guardian's name, admission date, etc. Also write a page `http://127.0.0.1:8000/helloweb/post_data` and a `post()` view function so that we are able to insert data into the database from a Web interface. Use the same statements we used in the Django shell interface to implement it.

This article has covered most of the bits and bytes at the basic level of Django Web application development. Once you get started coding in Django, you will definitely fall in love with it. The Django project website has excellent documentation available. You should always use `http://docs.djangoproject.com/en/1.1/` as the primary reference. 

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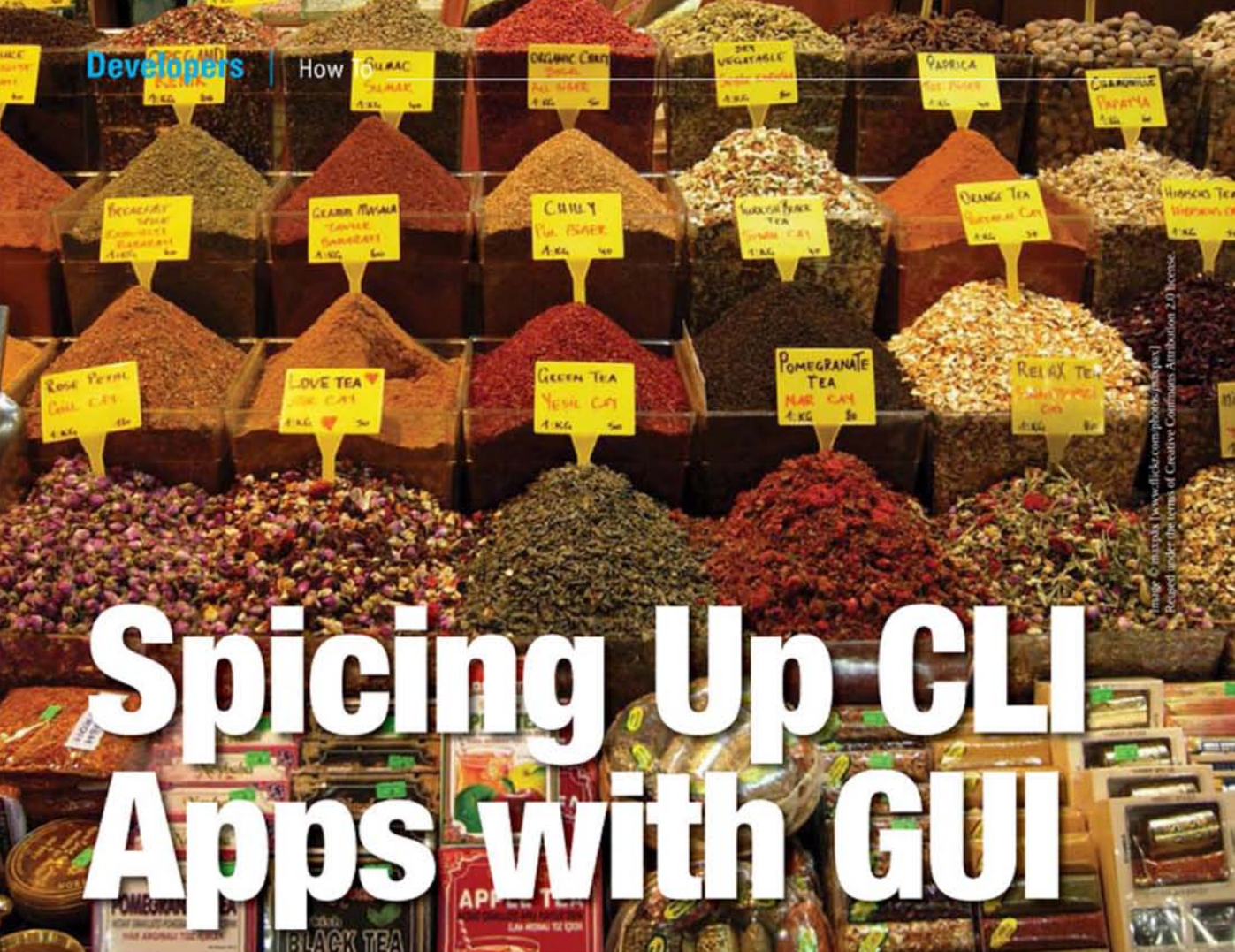
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Spicing Up CLI Apps with GUI

In this age of innumerable GUI-driven utilities on our GNU/Linux systems, we are bound to come across several command-line programs with boring and user-unfriendly text console-based operations. Wouldn't it be fun if we could add some GUI features to command-line applications without any tedious GUI programming effort?

Dressing up a command-line program with some form of a graphical skin is possible with very little effort, using utilities like `Dialog` and `Xdialog`. We can use these for most programming languages like C, C++, Python, Ruby, Perl, Bash, etc, to create GUI-based applications, without any GUI programming effort at all.

In this article, we will explore how to turn our boring command-line applications into some spicier and more user friendly forms with a GUI. I used the Ubuntu 9.10 64-bit desktop edition and Puppy Linux 4.2.1 to test the code

and to generate the screenshots presented in this article.

Dialog and Xdialog

`Dialog` is a curses/ncurses libraries-based program that creates interactive text-mode graphical controls, or widgets, on text consoles. It can easily be plugged into existing command-line applications without the need for any serious programming efforts to turn text-based applications into interactive GUI-based utilities. The newer versions of `Dialog` are based on

ncurses libraries, so we can also use the mouse in console applications. There also exists a stripped-down lightweight version of Dialog known as *lxdialog*, which is used in Linux kernel configuration.

Xdialog is the functional counterpart of the Dialog program that produces various widgets in X. It uses the GTK+ library for its functionality, which means that we can smoothly integrate Xdialog in desktop environments like GNOME. So, using Xdialog we can incorporate graphics mode widgets in our command-line applications.

Also, for KDE, there exists a similar program like Xdialog known as *kdiallog*, but we'll leave that out of this article. In fact, after getting the feel of Dialog and Xdialog, you can handle similar utilities pretty much in the same manner. So readers are encouraged to explore *kdiallog* from the tutorial link provided under the *References* section at the end of the article.

Installation

To my surprise, both Dialog and Xdialog came preinstalled in Puppy Linux 4.2.1. On Ubuntu 9.10, the easiest way is to issue the following command on a text console:

```
sudo apt-get install dialog
```

Ubuntu 9.10 also contains a utility known as 'Whiptail', which provides some of the functionality of Dialog, but is based on the Newt library. I found Whiptail very limited with respect to the widgets it offered and the configuration options it provided. We will discuss it later on in the article.

Installation of Xdialog on Ubuntu 9.10 involved more work. I had to install it from source as there wasn't any installation candidate for it in the software repository. To install Xdialog from source, I first had to download and install the following *.deb* packages in the same order as shown below (note that Xdialog requires the gtk-1.2 series only and not other versions of GTK):

1. *libgtk1.2-common_1.2.10-18_all.deb*
2. *libglib1.2_1.2.10-10.1build1_amd64.deb*
3. *libgtk1.2_1.2.10-18_amd64.deb*
4. *libglib1.2-dev_1.2.10-10.1build1_amd64.deb*
5. *libgtk1.2-dev_1.2.10-18_amd64.deb*

Once done, I downloaded the latest Xdialog sources from its home page, uncompressed its tar archive and moved to the source directory that had been created by typing the following commands:

```
tar -jxvf Xdialog-2.3.1.tar.bz2
cd Xdialog-2.3.1
```

To finally build and install Xdialog, I ran the following command:

```
./configure && make && sudo make install
```

So we are now ready to play around with Xdialog.



Figure 1: infobox widget in action

First, let's learn Dialog

Getting started with Dialog is straightforward—think of it as a command provided by our shell. We provide different common widget options with it to do different widgets operations. The general form of *dialog* usage is as follows:

```
dialog <common options> widget <widget options>
```

The *<common options>* are optional settings that modify the appearance and behaviour of Dialog widgets. The *<widget options>* are combinations of the required and optional settings to create widgets. Note that in the man pages, the widgets options are mentioned as box options.

There are many options we can use with Dialog, but here we will experiment with just a few. I encourage you to tweak the remaining options.

Some common options that we will use along with their functions are:

- *--backtitle titlestring* – The background canvas of Dialog widgets usually doesn't have any text. By using this option, we can show some text on it.
- *--title titlestring* – By using this option we can add some text as a title to widgets.
- *--stdout* – By default, some of the widgets that emit an output, write it to the screen. We can use this option if we want to gather the output, without having it written to the screen.
- *--begin ypos xpos* – By default, all the widgets are positioned towards the centre of the text console screen. We can change that using this option, by stating the y and x positions from the top left corner of the text console.
- *--timeout sec* – All widgets, by default, only return when Esc is pressed, if any of the widget buttons are selected and Enter is pressed, or if the mouse is clicked over any of the buttons. Using this option, we can tweak the default behaviour by specifying the interval in seconds, after which the widget automatically returns.
- *--sleep sec* – This one inserts a delay for the specified number of seconds after processing the Dialog widget.
- *--no-shadow* – By default, a shadow is shown to the right and bottom of the widgets to create an illusion of depth. Using this option, we can turn it off.

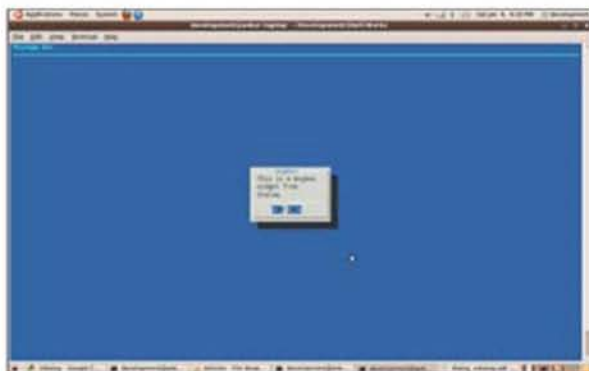


Figure 2: msgbox widget with title texts

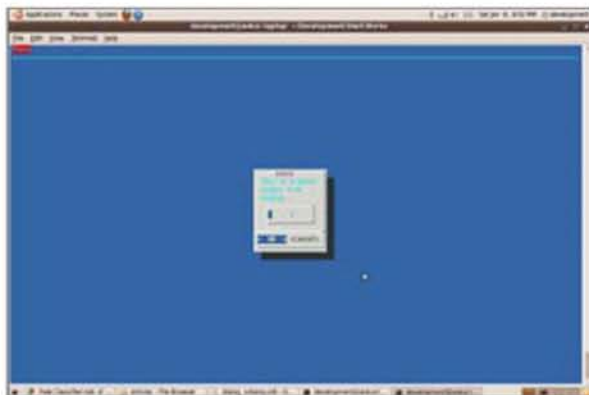


Figure 3: Pause widget with --color option

- **--colors** – With this, we can change the video attributes of the Dialog titles' text.
- **--insecure** – By default, the password widget created by Dialog doesn't echo what we type on the text console screen. We can see typed characters echoed as asterisks, using this option.

Let's now start playing with the Dialog widgets. The latest version provides the following widgets: calendar, checklist, dselect, editbox, form, fselect, gauge, infobox, inputbox, menu, mixedform, mixedgauge, msgbox, passwordbox, passwordform, pause, progressbox, radiolist, tailbox, tailboxbg, textbox, timebox, yesno, etc.

Let's explore some of these now. Run the following command on a console:

```
dialog --infobox "This is just an infobox widget from dialog." 0 0
```

As you can see in Figure 1, this will draw an infobox widget with the information we specified.

After creating the infobox widget, Dialog immediately returns the console prompt. As you probably have guessed, this widget's purpose is to display information and quit immediately. I've passed two zeros in the above command for the height and width of the widget—passing 0 makes Dialog take care of the widget's height and width. You can consider 0 0 for the height and width, respectively, as very

safe values, most of the times.

You'll also notice in Figure 1 that the infobox widget doesn't have any title text, neither on the message box nor on the background. Let's add the title in our next example:

```
dialog --backtitle "Message Box" --title msgbox \
--msgbox "This is a msgbox widget from dialog." 0 0
```

Can you see the title texts in Figure 2 now? Also, if you press *Esc*, *Enter* or left-click on the OK button, then Dialog returns. We will look into these actions when we discuss the uses of Dialog widgets in shell scripts, later in the article.

Till now we have only looked at some boring default colours for texts. We can change the attributes and colours of these text messages passed to Dialog simply by embedding '\Z' sequences in different texts passed to Dialog, along with the **--colors** option. Enter the following command to see it all in action:

```
dialog --colors --backtitle "\Zr\ZlPause\Zn" --title "\Zu\ZSpause\Zn" \
--pause "\Zb\Z6This is a pause widget from dialog." 10 20 15
```

Can you see some colourful texts in and around the pause widget as shown in Figure 3? A pause widget shows a meter bar that keeps on decreasing with every elapsed second. If you don't press *Esc*, or hit the OK/Cancel buttons during the seconds remaining, the widget returns once the timeout value passed to it has elapsed. The various text attributes and colour values with embedded '\Z' sequences in various title strings are:

- **r** : reverse
- **b** : bold
- **u** : underline
- **n** : restore normal settings
- **0** : black
- **1** : red
- **2** : green
- **3** : yellow
- **4** : blue
- **5** : magenta
- **6** : cyan
- **7** : white

We can also change the default titles of the *OK* and *Cancel* buttons, or show an extra button with the desired text in the widgets. Enter the following command to see these processes in action:

```
dialog --backtitle Calendar --title calendar --extra-button \
--extra-label "Extra step" --ok-label "Ok computer" \
--exit-label "Bye bye" --calendar "Please select a date" 0 0
```

Take a look at Figure 4. We have inserted a new button and customised the texts of all the buttons here. We can move between different sub windows of the calendar widget using *Tab*. If you select to click on any of the buttons except *Esc* or hit the *Cancel* button, then you will see the selected date printed on the widget itself. This is the default

behaviour of all Dialog widgets—that is, to return some value(s). We can change this behaviour using the `--stdout` option, which is demonstrated in the next section where we use Dialog widgets in shell scripts.

We can also specify the starting locations of Dialog widgets and turn off the widget shadow. Enter the following command to see this in action:

```
dialog --no-shadow --begin 4 4 \
--backtitle "Input Box" --title inputbox --inputbox \
"Please enter something you like" 0 0 "FOSS ruiz..."
```

If you check Figure 5, you'll notice that the inputbox widget is drawn at the top-left corner of the screen, rather than in the centre. This is the property of the `--begin` option. Also, the shadow has dissipated because of the `--no-shadow` common option. The inputbox widget shows a default string we provided on the Dialog command line, but we can change this string using the Delete or Backspace key and enter our desired input.

Till now, we have entered all the Dialog commands on the text console, but there is also an option to read Dialog parameters from a given file. Using the `--file` common option, we can put our commands in dialog `--file paramfile` form, where *paramfile* contains other Dialog parameters. This way we can control our widgets through their respective parameter files only.

We can also chain various Dialog widgets using the `--and-widget` option. Type the following command to see this process in action. Check Figure 6 for the output.

```
dialog --backtitle "Multiple dialog widgets" \
--begin 4 4 --title msgbox1 --msgbox First 0 0 \
--and-widget --begin 10 10 --title msgbox2 --msgbox Second 0 0 \
--and-widget --begin 16 16 --title msgbox3 --msgbox Third 0 0 \
--and-widget --begin 20 40 --title infobox1 \
--infobox "There are multiple widgets." 0 0 \
--and-widget --begin 30 35 --title infobox2 --infobox "I'm here too." 0 0
```

By now you must have a fair idea about some of the Dialog widgets and how to tweak their default behaviour using various options.

Dialog with shell scripts

To incorporate Dialog widgets in new or existing shell scripts we need to put the Dialog commands in the scripts along with two other considerations:

1. The value a widget returns to further process the script, if any; and/or,
2. The return status of the Dialog command to see what keyboard or mouse action the user has performed on the widget.

Use the `--stdout` option in the Dialog command line to obtain the value returned by a widget. To determine the kind of action taken on a widget, we have to examine the inbuilt shell variable `?` that returns the exit status of the

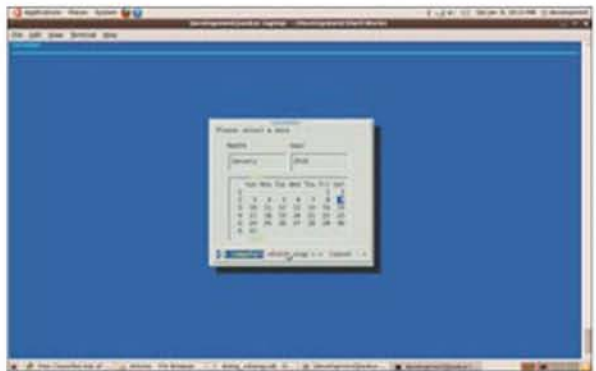


Figure 4: Calendar widget with an extra button

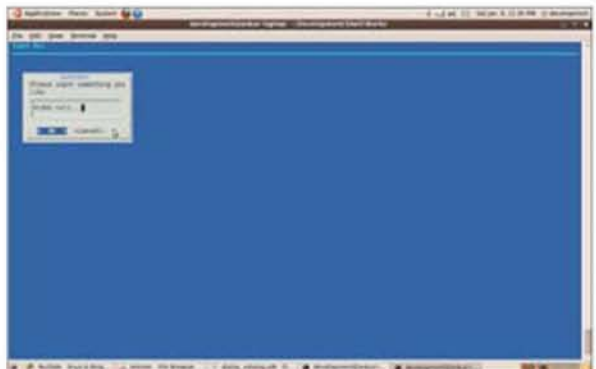


Figure 5: inputbox widget with the `--begin` and `--no-shadow` options

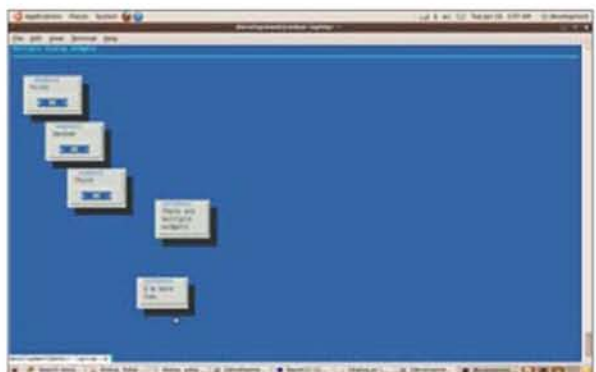


Figure 6: Multiple Dialog widgets

previous command.

The following shell script combines these concepts with some other Dialog widgets we haven't tried out yet. This shell script presents a menu with various options to select, and according to the options selected, information is displayed. Execute this shell script to see this feature in action.

```
#!/usr/bin/env bash

# variables to hold command and common options.
dig=dialog
stdo=-stdout
titl=-title
```



Figure 7: Example of how the shell script pops open the menu widget



Figure 8: Textbox widget displaying the content of a selected file

```

titlbg=--backtitle

# function to handle open file choice.
fileselect() {

    file=$(Sdlg $stdo $titlbg "Menu choice was file selection dialog" \
        $titl "Select file" --fselect - 0 0
    )

    if [ $? -eq 0 ]
    then
        Sdlg $titlbg "Selected file content" $titl $file -textbox $file 0 0
    fi
}

# function to handle choose directory choice.
dirselect() {

    directory=$(Sdlg $stdo $titlbg \
        "Menu choice was directory selection dialog" $titl "Select directory" \
        --dselect - 0 0
    )

    if [ $? -eq 0 ]
    then
        Sdlg $titlbg "Selected directory info" $titl "Directory Info" \

```

```

        --infobox "Your chosen directory is : $directory" 0 0
    fi
}

# function to handle show timebox choice.
timebox() {

    time=$(Sdlg $stdo $titlbg "Menu choice was Time Box." $titl "Select time" \
        --timebox "Choose your favourite time" 0 0
    )

    if [ $? -eq 0 ]
    then
        Sdlg $titlbg "Selected time info" $titl "Time Info" \
            --infobox "Your favourite time is : $time" 0 0
    fi
}

# menu widget to show various choices.
choice=$(Sdlg $stdo $titlbg "Dialog usage in shell script" $titl \
    "Action menu" --menu "Make a choice to proceed" 0 0 \
    1 "Open file" \
    2 "Choose directory" \
    3 "Show timebox" \
)

# we are interested only in Ok button event.
if [ $? -eq 0 ]
then

    # now handle the selected choice.
    if [ "$choice" = "1" ]
    then
        fileselect
    elif [ "$choice" = "2" ]
    then
        dirselect
    elif [ "$choice" = "3" ]
    then
        timebox
    fi
fi

```

Figures 7 and 8 show what happens when you execute the above shell script. Do you see how by using Dialog we turned this otherwise boring text-based shell script into an interactive wizard?

By exploring the concepts we have covered so far and reading the man pages, you can use Dialog widgets in several ways, only limited by your imagination.

Something about Xdialog

Consider Xdialog as an X-based counterpart of Dialog. It refines Dialog widgets further with some extra options and

contains some additional widgets as well. Most of the time, we can apply our working knowledge of Dialog to Xdialog, as it is.

The general form of an Xdialog command is as follows:

```
Xdialog <common options> <transient options> widget <widget options>
```

Here transient options are nothing but some Dialog options and other new options added to Xdialog.

Let's now dirty our hands with some Xdialog widgets, shall we? Issue the following commands:

```
Xdialog --backtitle "colorsel" --title "Color Selection Widget" \
--colorsel "Choose your favourite color" 0 0 123 234 89 &
```

```
Xdialog --backtitle "fontsel" --title "Font Selection Widget" \
--fontsel "Times 12" 0 0 &
```

```
Xdialog --backtitle "3rangebox" --title "3 Range Selection Widget" \
--3rangebox "Select your values" 0 0 first 10 56 34 second 3 89 56 \
third 4 67 45 &
```

Figure 9 shows the corresponding Xdialog widgets. See how easily, with just some single-line commands, we are able to produce some true graphical widgets like colour selection, font selection, and range selection dialogue boxes?

(X)dialog with other languages

We can use Dialog and Xdialog from any programming language that supports calling external executables. The advantage lies in the fact that we have a way to add graphics to our programs without much effort. It could also serve as a way for rapidly prototyping GUIs.

Let's look at how to mix what we've learned, with Python scripts. Take a look at the following code snippet, where we create various widgets in a mixed manner. First it asks you the password key (that is, lfyrockz) and then after taking some more inputs, it provides a message to you in the end.

Please note that in the dictionary of Dialog and Xdialog commands, the various parameters are separated by a pipe character (|) to allow spaces in the various strings we pass. Copy the following code to a file (filename.py) and run it using python filename.py from a console:

```
#!/usr/bin/env python2.6

from subprocess import Popen, PIPE, STDOUT

# dictionary to hold various dialog and Xdialog commands.
dwgdtstb = {
    'dlgpasswd': ('dialog--stdout--insecure--backtitle>PasswordBoxWidget'
        + '--title[passwordbox]--passwordbox[Enter the key|0|0]'),
    'xdlgname': ('Xdialog--title[Xinputbox]--inputbox[Enter your name|0|0]',
        'xdlgdob': ('Xdialog--title[Xcalendar]--calendar[Select your DOB|0|0]',
    'dlgtime': ('dialog--stdout--backtitle|TimeBoxWidget|'
```



Figure 9: Widgets provided by Xdialog

```
* '--title[timebox]--timebox[Select time of birth|0|0]',
'xmsg' : 'Xdialog--title[XmsgBox]--msgbox[message|0|0]',
}

def execute(scommand):
    """
    Routine to execute a command string and return (output, error, status)
    of the command.
    """
    l = scommand.split('|')
    p = Popen(l, stdout=PIPE, stderr=STDOUT)
    toe = p.communicate()

    return (toe[0], toe[1], p.returncode)

def main():
    """
    Application driver routine.
    """
    tpswd = execute(dwgdtstb['dlgpasswd'])

    tname = {}
    tdob = {}
    ttime = {}

    if 'lfyrockz' == tpswd[0].strip():
        if not tpswd[2]:
            tname = execute(dwgdtstb['xdlgname'])

        if not tname[2]:
            tdob = execute(dwgdtstb['xdlgdob'])

        if not tdob[2]:
            ttime = execute(dwgdtstb['dlgtime'])

        if not ttime[2]:
            smsg = ('Hi ' + tname[0].strip() + '\n' +
                'Your DOB is : ' + tdob[0].strip() + '\n' +
                'Time of birth is : ' + ttime[0].strip() + '\n' +
                'LFY wishes you the best.')
```



Figure 10: Dialog passwordbox and Xdialog inputbox widgets



Figure 12: Whiptail and Zenity in action



Figure 11: Dialog timebox and Xdialog msgbox widgets

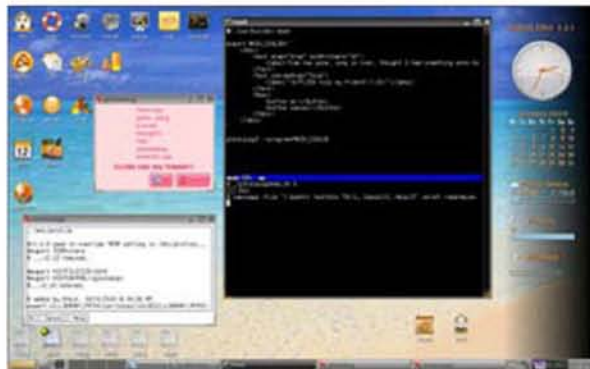


Figure 13: Gtkdialog and Xmessage in action

```
execute(dwdgtsatrb['xmsg'].replace('message', msg))

else:
    msg = 'Incorrect password, better luck next time.'
    execute(dwdgtsatrb['xmsg'].replace('message', msg))

if '__main__' == __name__:
    main()
```

Figures 10 and 11 show what happens when we execute the Python script—note the co-existence of Dialog and Xdialog widgets in the screenshots.

Some other similar utilities

In this section, we are going to touch on some other utilities similar to Dialog and Xdialog. I found gtkdialog and xmessage preinstalled on Puppy Linux, and Zenity and Whiptail came preinstalled with Ubuntu.

As mentioned earlier, Whiptail provides fewer options and widgets than Dialog. It only provides yes/no, menu, input, message, text, info, checklist, radiolist, gauge and password boxes. Type the following command to see the password widget of Whiptail in action:

```
whiptail --fb --title "Whiptail Password Widget" \
```

```
--passwordbox "Enter your password" 10 0
```

Zenity is another utility we can see as a subset of Xdialog. It provides some decent GTK+ widgets and common options in terms of functionality. Type the following commands to see it in action:

```
zenity --info --text="This is an info from Zenity." &
zenity --warning --text="This is a warning from Zenity." &
zenity --question --text="This is a question from Zenity." &
```

Now take a look at Figure 12 to see both Whiptail and Zenity in action.

Coming to Xmessage, it's actually a command to provide a very limited-functionality GUI widget. It only shows a message with user-defined buttons. Run the following command:

```
xmessage -file ~/.bashrc -buttons "Ok:1, Cancel:2, Help:3" -print -nearmouse
```

The `-file` option reads information from a supplied file; and we create various buttons by providing a comma separated list of `title:returcode` to the `-buttons` option. On clicking a button, the corresponding return code is returned. So on the basis of the returned value, we can do further processing.

The functionality of Gtkdialog is very different from all the utilities we have discussed till now. This one creates

various widgets from an XML-like description, known as Dialog description language. Through this description language, we can create very complex Dialog boxes containing other widgets and boxes. The downside is that it involves much more work compared to what we've discussed till now.

Copy the following code in some file and save it with a .sh extension, say `filename.sh`:


```
#!/usr/bin/env bash

# dialog description assigned to an environmental variable.
Export MAIN_DIALOG='
<vbox>
  <text wrap="true" width-chars="10" >
    <label>Time has gone, song is over, thought I had something more to say.</label>
  </text>
  <text use-markup="true">
    <label>"<b>FLOSS rulez my friend!!!</b>"</label>
  </text>
  <hbox>
    <button ok></button>
    <button cancel></button>
  </hbox>
</vbox>
'
```

`gtkdialog3 --program=MAIN_DIALOG`

Now, make `filename.sh` executable and run it to see Gtcdialog in action.

Figure 13 shows the outputs after executing the Xmessage and Gtcdialog commands/scripts.

So we have seen how we can transform any command-line application into a user-friendly graphical application. This is not only useful to put life into older console-oriented utilities but also for the programs you write yourself. In fact, many existing GNU/Linux applications, ranging from installers to kernel configuration utilities, employ these utilities. **END** 

Resources

- dialog home page: invisible-island.net/dialog
- Xdialog home page: xdialog.dyns.net
- gtkdialog home page: linux.ptt.hu/~pipas/gtkdialog/index.html
- kdialog tutorial: techbase.kde.org/Development/Tutorials/Shell_Scripting_with_KDE_Dialogs#Introduction_and_Scope

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The Salient Features of the Consumer Electronics Linux Forum Specifications

Part 1

From a handheld device that sits comfortably in your palm, to the majestic LCD television that adorns the walls of your house, consumer electronics has become ubiquitous in today's world. Embedded Linux is gaining momentum because of the advances in audio and video technologies, and the user friendly features of Linux. Hence, understanding the significant features of Linux in order to use it in embedded devices is critical for the Linux developer community. Here, we touch upon the salient features of the CELF specifications to expand your knowledge on Linux in the embedded arena.

By 2015, it is estimated that on an average, there will be five consumer electronics devices per person in the developed and developing world. That will add up to more than two trillion devices. If these devices are to be Linux-powered, then what are the important features that Linux must have?

The CELF (Consumer Electronics Linux Forum) community has provided guidelines in the form of CELF specifications, which focus on the significant characteristics of Linux for CE (consumer electronics) devices. Linux has many desirable features that can be used in embedded devices. The top device manufacturers — Sony, Toshiba, NEC, Panasonic, Sharp, Samsung and Philips — have come together to form the CELF and draw up the specifications [1].

The CELF specifications focus on:

- 1) Boot-up time reduction
- 2) Power management
- 3) Audio and video specifications

- 4) Real-time characteristics
- 5) Size reduction
- 6) Linux security

An embedded Linux developer needs to understand how to enable features such as a tickless kernel or device power management, and what can be expected if the feature is in the build. On the other hand, an embedded system architect using Linux will find enough juice in this article to comprehend the broad focus areas, while designing a product powered by Linux. We serve ready-made and easy-to-use information for the embedded system architect, Linux developer and avid reader who want to dig deeper.

While analysing the existing features of the CELF, this review aims to provide a good description of the features, along with information on whether the feature is integrated in the mainline version of the kernel. We will also show you the options to enable the embedded Linux features. Experimental and reported data will be provided to throw more light

on the use of certain features in the devices, and industry environments that use these features.

Let us begin with getting an insight into the salient features of the CELF specifications [1]. Due to the volume of information that needs to be presented, we have split the article into two parts. In Part I we will discuss boot-up time reduction and power management. We will focus on real-time characteristics and size reduction in Part II.

Boot-up time reduction

The need for a reduction in the boot-up time is obvious. People want to get started fast. This is more so if you are talking about a handheld device or a television—users expect them to work as soon as they are turned on.

Tim Bird, chair of the Architecture Group in CELF [2], said that there are four principles of reducing boot-up time. Whatever you do during boot-up:

- Do it fast (see if you can speed up an activity during boot-up)
- Do it in parallel (get things done during boot-up, in parallel)
- Do it later (postpone unnecessary activities that are traditionally taken care of during boot-up)
- Don't do it at all (see if you can avoid doing an activity during boot-up)

There are multiple ways in which you can reduce boot-up time.

Let us explore each of the following techniques in greater detail:

- XIP
- IDE no probe
- Disabling console output
- Delay loading drivers
- Smaller kernel
- Excellent quick boot

XIP

XIP stands for eXecute In Place, which means executing the kernel in the same place it is stored (i.e., from the ROM, persistent memory storage).

XIP comes under the 'Do it Fast' category—while performing an activity during boot-up, find ways to finish it quicker. In the conventional method, the kernel image is copied from ROM to RAM, uncompressed in a different location in the RAM and then executed. (See Figure 1.)

But XIP is a method for executing code directly from ROM or Flash, without first loading it into RAM. Kernel XIP refers to the capability for a Linux kernel to be executed directly from a persistent, read-only memory or media type (Figure 2). When the kernel is executed in this fashion, the boot loader can avoid loading the kernel from persistent storage on to RAM, uncompressing it, and saving it into the system RAM [3], [4] and [5].

This will impact start-up time, RAM and ROM footprint, and execution performance. Reduction in boot-up time occurs mainly in two phases. The time it takes to copy the kernel image from the ROM to the RAM is reduced, in addition to a reduction in the time it takes to uncompress the image after copying it on to RAM. For a slow processor, this can take around 1.5 to three seconds.

Kernel XIP has the following advantages, with some overhead of running the kernel due to frequent access of

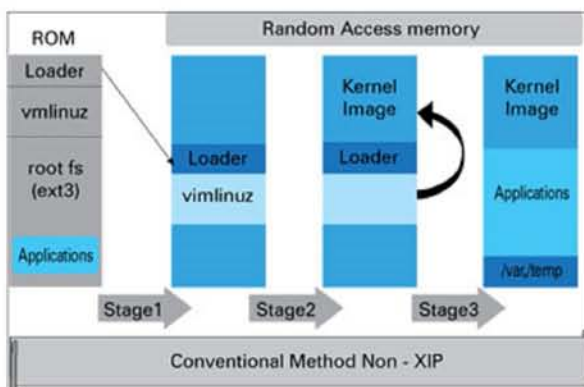


Figure 1: Different phases in conventional boot loading procedure

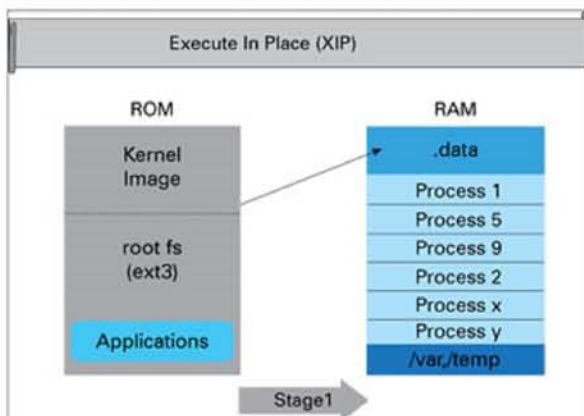


Figure 2: Different phases involved in XIP procedure

Flash memory:

- It provides faster boot-up time by reducing the time to copy from ROM to RAM and by completely eliminating decompress time.
- It also has smaller RAM footprint since the kernel text portion is not loaded in to RAM.

IDE no probe

Linux probes for the presence of different sectors of the hard drive, the USB, SDRAM drive and other such drives. This time could be saved if we disable the probing of the unused drive, by using `ide no probe = <x>` (where <x> is the drive name) [6] and [7]. Data provided by Tim Bird says that the time to probe an empty IDE (Integrated Drive Electronics) device is approximately 1.3 sec [6].

'IDE no probe' comes under the category of 'Do it Later'—see whether you can postpone an activity done during the boot-up [6], [7] and [8].

Disabling the console output

The console output can be disabled for faster boot-up time. In actual devices or in production times, the console output is not needed [9]. Console output can be disabled with the `quiet` argument in the Linux kernel command line (boot loader settings):

```
root=/dev/ram0 rw init = /startup.sh quiet
```

You can still see the messages through the `dmesg` command. Disabling the console output comes under the category of 'Don't do it at all'—see whether you can postpone an activity done during the boot-up.

Delay the loading of drivers

The loading of a few drivers can be delayed and this can also considerably reduce the boot-up time. For example, certain drivers can be loaded later in the boot sequence or in parallel with other drivers or applications. This comes under the category of 'Do it Later' [2]—see whether you can postpone an activity done during the boot-up [6].

Smaller kernel

The Linux kernel will load faster if it is lean and trim. In that sense, the CELF's specification on size reduction, indirectly contributes to boot-up time reduction also.

The Linux kernel is designed for servers and desktops. Embedded systems are dedicated systems and hence they do not require many features that are applicable for servers. During kernel configuration, we can disable kernel features not required, which results in kernel size reduction. Further information on having a smaller kernel is provided in the second part of this article.

An excellent instant loading technique

Boot up the kernel, start all the applications and the user interface, then suspend to disk or flash in the same state. When the device is booted again, the system state is restored from this predefined hibernation image. This technique is followed in the Sony Digital Still Camera and a few handheld devices. With this technique, it is possible to achieve instant 'Power On' in less than 400 msec [3].

Power management

One USP (unique selling proposition) consumer electronics device manufacturers certainly need is low power consumption. Power management has gained significance of late because of the importance given to longer battery life in handheld devices and mobile phones, and also because of the campaign to turn green. What is the cause of higher power consumption in CE devices?

Well, if you were to dig deep into the roots of devices and circuits, you will find that power consumption in embedded devices depends on three factors.

1. Leakage current power dissipation
2. Dynamic current power dissipation
3. Short circuit current power dissipation

Leakage current power dissipation is due to the flow of leakage current and this is dependent on operating voltage [1].

Dynamic current power dissipation is due to the flow of dynamic current and this is the most important form of dissipation. This power dissipation will occur when the device is active, and it is dependent on the operating voltage and the frequency of input.

Short circuit current power dissipation is due to the flow of short circuit current and it is also dependent on voltage.



Figure 3: Option to enable frequency scaling during kernel configuration

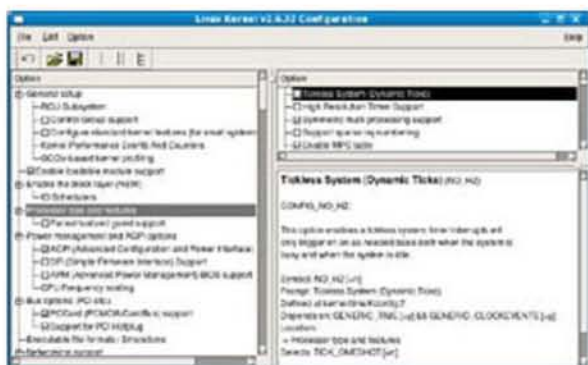


Figure 4: Option to enable the tickless kernel during kernel configuration

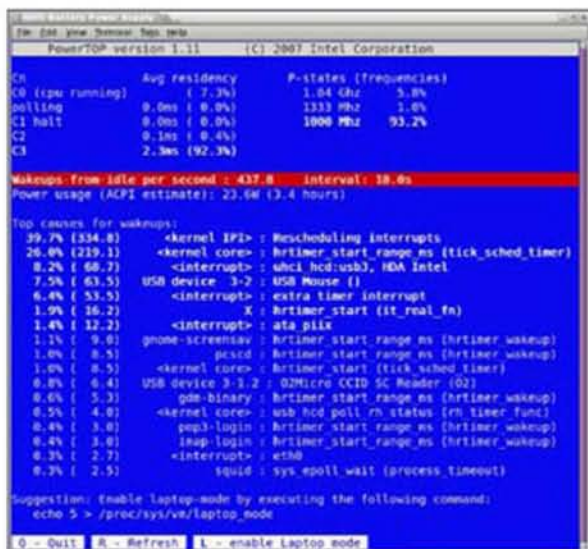


Figure 5: Power Top output when a laptop runs on battery power supply

Among the three forms of power dissipation, only dynamic current power dissipation is proportional to voltage and frequency ([1] and [6]).

The principles of power management are:

1. Scale down (to reduce the voltage or frequency)
2. Cut off (completely disconnect the voltage or frequency)

There are different methods with which you can take care of power management factors in CE devices. They are:

- Dynamic voltage and frequency scaling (DVFS)
- Tickless kernel
- Power Top (power consumption monitoring tool)
- Suspend/resume
- Device power management
- Dynamic power management

Dynamic voltage and frequency scaling

The bottom line is that power dissipation can be reduced if we reduce or cut off the voltage or frequency. There are certain preset values for the voltage, current and frequency for each device, device state and set of inputs. This is called the operating point (OPP). This operating point can be dynamically set when the device is working. This is called DVFS (dynamic voltage and frequency scaling). The option to enable frequency scaling is shown in Figure 3. In fact, DVFS is about dynamically changing the operating point (OPP) to suit execution environments [3].

The tickless kernel

The system produces a timer interrupt every 1 ms (if the timer frequency is set to 1000 Hz), and when this interrupt occurs, the CPU stops what it is doing and executes the timer interrupt handler function. In the interrupt handler function, there are different tasks to be done, such as checking if there is any other higher priority task to be done [10].

On an idle system, the processor wakes up every time a timer interrupt is received, only to find that there is nothing else to do. Can we disable the timer interrupt when all the processors are idle, and enable it only when there is something to be done or when there is an interrupt?

If we do this, then it is called a tickless kernel. If there is less work to do in the device, the tickless kernel sends the processor into sleep mode whenever it's possible, and this reduces power consumption. Figure 4 shows the option to enable the tickless kernel feature.

There is reported data available through the ELF Conference about a machine working on Intel Core Duo at 1000 Hz. A comparison was made of the CPU idle residency — with and without ticks. It was found that when the number of interrupts was reduced by 20 times, the CPU idle time increased by 10 times, which would result in considerable power savings.

Power Top

Power Top [11] is a utility that can give you the top 10 power consuming tasks in the system. It is only a power consumption monitoring tool to guide you to optimise the application that is consuming more power and bring the overall power consumption under control. Figures 5 and 6 show the output of the Power Top tool when a laptop is running on battery power supply and when it is connected to the main power supply, respectively.

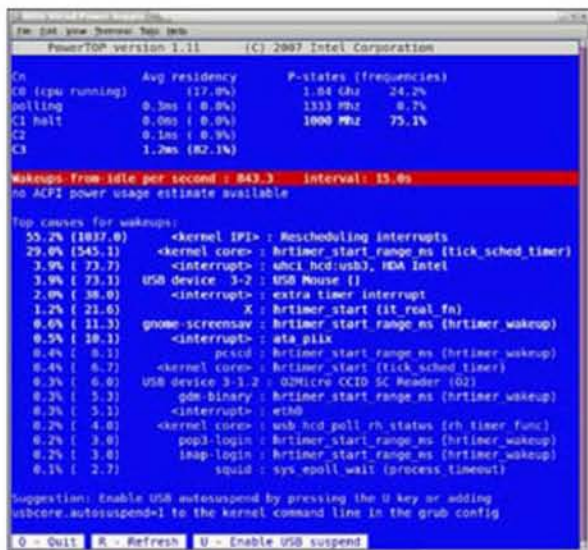


Figure 6: Power Top output when a laptop runs on the main power supply



Figure 7: Option to enable suspend to disk and resume

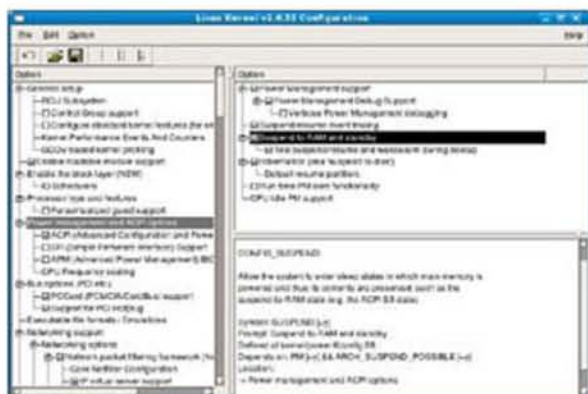


Figure 8: Option to enable suspend to RAM and resume

Suspend and resume

The kernel provides hooks and device drivers to support suspend/resume operations when there are long periods of idle

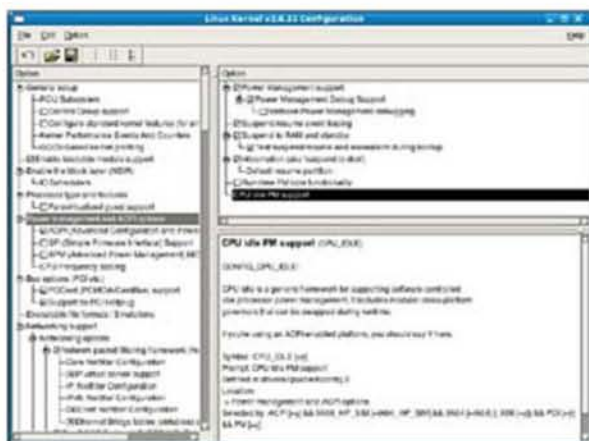


Figure 9: Option to enable 'CPU Idle Power Management' support

time on a device. You can also trigger the system to go into a *suspend* state by issuing the following command:

```
echo mem > /sys/power/state
```

The *suspend/resume* activity comes under the category of static power management. When in a suspended state, the system slows down or stops various clocks, removes power for devices or places them in a low-power state, thus lowering the core operating voltage and stopping the CPU. The power management subsystem in the 2.6 kernel implements a kernel API for *system suspend* and *resume* with limited support for choosing a specific *system suspend* state. The 2.6 *sysfs* filesystem exports interfaces that applications may use to suspend the system [3] and [12].

You can suspend to disk and resume (which is called 'hibernate') or you can suspend to RAM, as is done in many handheld devices. Figures 7 and 8 show how to enable these options during kernel configuration.

Device power management

It is a hardware or software mechanism that triggers a device into a low-power state after a period of inactivity. For example, a driver powers down the device because applications no longer hold an open reference to it. When the last open file descriptor for a device is closed, then the driver may suspend the device. Figure 9 shows the option to enable 'CPU Idle Power Management' support.

Dynamic power management

This refers to the dynamic control of clocks and power supplies, the adjustment of timer ticks, voltage and frequency scaling. This basically means power management when the device is active (i.e., when user applications are running). This can be done based on the processing load. Device drivers and operating systems can also contribute to the dynamic power management by reducing the speed of disks when the system is idling. Dynamic power management uses a combination of both user space and kernel space software.

In dynamic power management, you adjust power parameters on-the-fly when simultaneously making sure real-time requirements are satisfied. This uses recent improvements in hardware to scale clocking information and required voltages with reduced latency [13] and [14].

Dynamic power management focuses on quick application restart after standby, automating system parameters, where the power parameters are automatically selected based on CPU load, the number of high priority tasks existing, etc. Ultimately, more flexibility is available to the systems designer in constrained working environments such as the consumer electronics devices, in order to control the system parameters [3] and [15].



Note: We'll discuss real-time specifications and size reduction next month. **END**

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Gururajan currently works with Wipro Technologies as a lead consultant in the wireless and embedded domain. He has 16 years of core technology experience after a master's degree in engineering and has worked with various multinational companies in the USA, Germany and India. His specialisation is in wireless communication, algorithms and data structures, and Linux systems programming. Dr Thangaraju received a PhD in physics and worked as a research associate in IISc from 1996-2001. From 2001, he has been working in Wipro Technologies as a senior consultant and his core expertise is the Linux kernel, with expertise in embedded and real-time Linux.



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Calibrate Your C Code

A seemingly minor change in how a program is written can bring about a major performance up-grade or vice versa. This article discusses a few techniques to write efficient and optimised C or C++ code.

Any efficient code requires: (a) the selection of the best algorithms and data structures, and (b) code written in a way that the compiler can effectively optimise and generate the best executable.

Ideally, any standard compiler takes whatever code you supply to it and tries to generate the most optimised executable possible, on its own. However, this is not the best practice—a very limited transmutation happens because of many blockers. And prominent among these optimisation blockers is machine-dependency—that is, its dependency on the low-level architectural details of the machine.

Optimising memory references

Performance can depend heavily on many lineaments of the processor design. Therefore, to maximise the performance of a program, both the programmer and the compiler need to understand the target architecture. Understanding the instruction set is another effective way to find out how the code will run, i.e., how frequently memory is referenced and how effectively the machine registers are

being used. Let's consider the following code snippet:

```
void foo (int *x, int *y)
{
    *x = *y;
    *x += *y;
    return;
}

void opt_foo(int *x, int *y)
{
    *x = 2 * *y;
    return;
}
```

Although both the above functions (*foo* & *opt_foo*) have identical behaviour, *opt_foo* is more efficient. Let's see how.

The function *foo* requires five memory references (one read of **x*, two reads of **y*, and two writes of **x*), whereas *opt_foo* just requires two memory references (one read of **y*, and one write of **x*).

Avoiding unwarranted function calls

Another performance blocker may happen due to unwarranted calls to

functions. As an example, you can consider the following two functions:

```
void foo(char *str)
{
    int ctr;
    for(ctr = 0; ctr <= strlen(str); ctr++)
        print("%c", str[ctr]);
}

void opt_foo(char *str)
{
    int ctr, len = strlen(str);
    for(ctr = 0; ctr <= len; ctr++)
        print("%c", str[ctr]);
}
```

Which of the lines of code do you think is better?

foo() calls the library function *strlen()* multiple times. However, irrespective of achieving a similar result, *opt_foo()* calls *strlen()* just once. Here's how a function call works...

Each function code runs because of an immediate change in the value of the program counter (*pc*). But before jumping to call the function from its current state, the current value of *pc*, along with other values, needs to be

saved on to a stack. After a return from the called function, the program counter gets restored for leftover instructions. This is context switching at function level. This consumes time and memory. Needless to say, the function `opt_foo()` is more efficient and faster than `foo()`.

Let's consider another similar example:

```
int foo(int x)
{
    return calc(x) + calc(x);
}

int opt_foo(int x)
{
    return 2 * calc(x);
}
```

You may be tempted to believe that `opt_foo()` is better, because of its less number of calls to `calc()`. Right? Well, before you conclude anything, first have a closer look at function `calc()` to understand what it actually does.

```
int ctr = 0; /* global variable */
int calc (int x)
{
    ctr ++;
    return ctr * x;
}
```

The variable `ctr` in the above snippet is a global variable, and `calc()` modifies it. Hence, `foo()` and `opt_foo()` do not compute the same result. For example, let's assume that we call `foo()` with 5 as the argument. `foo()` will return 15 after calculation. However, `opt_foo()` with 5 as its argument will return 10.

So, the moral here is, although unnecessary function calls should be avoided, a careful logical analysis is also necessary. Otherwise, you may land in trouble with unstable and unpredictable behaviour of the system.

Use of unsigned integers

If you are sure that the value will never go negative, using unsigned integers is advisable, as processors can handle an unsigned integer better than a signed one.

Most of the mainstream C/C++

compilers, by default, implicitly consider an integer declaration as signed—i.e., `int x` will be considered as *signed int x*. Therefore, it's a good practice to always declare such variables explicitly to avoid any confusion.

Branch prediction

Another technique to tune your code and get a performance boost is branch prediction. It is the software's ability to hint to the processor which way a branch (the *if-then-else* structure) is about to go.

According to Wikipedia, "A branch predictor tries to guess which way a branch will go before this is known, for sure. The purpose of the branch predictor is to improve the flow in the instruction pipeline. Branch predictors are crucial in today's pipelined microprocessors for achieving high performance."

To programmers, the GCC also provides a built-in function `__builtin_expect()` and based on its two macros—`likely()` and `unlikely()`—indicates the branch prediction information to the compiler. This way the compiler generates a more intelligent binary where the expected result is favoured.

The following lines of code demonstrate the use of the `likely()` and `unlikely()` macros:

```
if (unlikely(x != NULL))
    foo();
if (likely(y != NULL))
    opt_foo();
```

Memory alignment and padding

Quoting Wikipedia again, "A memory access is said to be aligned when the datum being accessed is *n* bytes long and the datum address is *n*-byte aligned. When a memory access is not aligned, it is said to be misaligned."

An aligned memory access will have a less number of memory access cycles than misaligned memory access. Therefore, to ensure that memory is correctly aligned some irrelevant bytes are inserted by the compiler. This activity is known as padding.

With data types like `struct`, any standard C/C++ compiler tries to add padding. Let's consider the following:

```
typedef struct{
    char c;
    int i;
    short s;
}example_1;


typedef struct{
    char c;
    short s;
    int i;
}example_2;
```

Considering that a `char` takes 1 byte, a `short` takes 2 bytes, and an `int` takes 4 bytes, `example_1` will consume 12 bytes. However, `example_2` will only take 8 bytes. This is because, in the above code snippet, the compiler tries to align the structure in the power of the size of an integer.

Hence, in the first case (`example_1`), three 4 bytes are assigned. However, in the second case (`example_2`), since a `char` and a `short` is accommodated within a single 4-byte boundary, we have a structure size of 8 bytes (4 bytes for `char` and `short`, and 4 bytes for `int`). Using these kinds of small tweaks you can always save significant amount of memory.

For further details on this topic, visit en.wikipedia.org/wiki/Data_structure_alignment.

A final note

I've only discussed a few common techniques here. There are many other ways (including many processor-dependent techniques) to fine-tune your code. I hope the examples in this article will inspire you to explore them on your own. 

Resources

- Wikipedia on branch predictor: en.wikipedia.org/wiki/Branch_predictor
- Wikipedia on data structure alignment: en.wikipedia.org/wiki/Data_structure_alignment

By: Vivek Kumar Prasad

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A Programmatic Introduction to SCTP



Since we've acquainted ourselves with the features and advantages of SCTP last month, let us put the concepts to practice by running through a simple client-server program using C.

SCTP socket APIs have been designed to maintain consistency with existing socket APIs. This helps in migrating existing TCP/UDP applications with the least effort. Let us have a look at some of them.



Note: SCTP provides two different API styles: one-to-one, and one-to-many. Currently, we are looking only at the one-to-one scenario since it enables existing TCP applications to migrate to SCTP with minimal changes.

```
int socket(PF_INET, SOCK_STREAM, IPPROTO_SCTP);
```

Once an endpoint has been created using the socket call, it has to be associated with a local address. This is achieved by invoking the *bind()* method:

```
bind(int sd, struct sockaddr *addr, socklen_t addrlen);
```

Once a transport address has been associated with the socket, the listen method must be invoked (by the server application, i.e., one that is expecting inbound requests for new

connections), to prepare the SCTP endpoint to accept inbound associations. The syntax for the *listen* call remains the same:

```
int listen(int sd, int backlog);
```

backlog represents the maximum number of outstanding associations allowed in the *accept* queue of the socket *sd*.

Server applications use the *accept* method to accept inbound client connection requests. The syntax of *accept* is:

```
client_sd = accept(int sd, struct sockaddr *addr, socklen_t *addrlen);
```

And, client applications use *connect* to initiate an association establishment sequence:

```
int connect(int sd, const struct sockaddr *addr, socklen_t addrlen);
```

Once a new association has been established between peers, most of the normal send/receive socket APIs can be used for communication. For example, if we consider *sendmsg/recvmmsg* APIs:


```
ssize_t sendmsg(int sd, const struct msghdr *message, int flags);
ssize_t recvmsg(int sd, struct msghdr *message, int flags);
```

Note that *sd* is the socket descriptor of the endpoint, and *message* is the pointer to the *msghdr* structure that contains the user message and ancillary data in the format:

```
struct msghdr {
    void      *msg_name;
    socklen_t  msg_namelen;
    struct iovec *msg_iov;
    size_t     msg_iovlen;
    void      *msg_control;
    socklen_t  msg_controllen;
    int        msg_flags;
};
```

...where:

- *msg_name* specifies the pointer to the socket address structure.
- *msg_namelen* specifies the size of the socket address structure.
- *msg_iov* includes an array of message buffers.
- *msg_iovlen* specifies the number of elements in the *msg_iov* structure.
- *msg_control* specifies the ancillary data.
- *msg_controllen* specifies the length of the ancillary data buffer.
- *msg_flags* specifies the flags on the received message.

Setting socket options

Socket options can be set using the *setsockopt* call—that is, options like enabling/disabling events (SCTP_EVENTS), RTO info (SCTP_RTOINFO), the number of in/out streams (SCTP_INITMSG), etc. For example, SCTP events can be enabled in the following manner:

```
struct sctp_event_subscribe events; /* Structure defined in net/sctp/user.h */
events.sctp_data_io_event = 1; /* 1 == interested in the event, 0 == not
interested */
events.sctp_association_event = 1;
events.sctp_address_event = 1;
events.sctp_send_failure_event = 1;
events.sctp_peer_error_event = 1;
events.sctp_adaption_layer_event = 1;
events.sctp_shutdown_event = 1;
events.sctp_partial_delivery_event = 1;

setsockopt(sd, IPPROTO_SCTP, SCTP_EVENTS, &events, sizeof(events));
```

Closing the association

A simple *close()* method invocation will initiate a graceful shutdown sequence (the SHUTDOWN chunk). But in case we need to close the association ungracefully (i.e., send an ABORT, instead of a SHUTDOWN chunk), we need to set the SO_LINGER socket option using the *setsockopt* method. If

this is set, any invocation of *close()* on the socket will initiate an ABORT chunk to the peer. For example:

```
struct linger ling={1,0};
setsockopt (sd, SOL_SOCKET, SO_LINGER, &ling, sizeof(ling));
```

The final picture

Let's use a few of the above methods and write a simple client-server program. The client sends a message to the server application that is echoed back by the server.

The following is the code for *server.c*:

```
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include <unistd.h>

#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <arpa/inet.h>
#include <sctp.h>

/* Method to handle SCTP Events */
void handle_event(void *buf)
{
    struct sctp_assoc_change *assoc_change;
    struct sctp_send_failed *send_failed;
    struct sctp_paddr_change *addr_change;
    struct sctp_remote_error *remote_error;
    union sctp_notification *notif;

    notif = (sctp_notification *)buf;

    switch (notif->sn_header.sn_type)
    {
        case SCTP_ASSOC_CHANGE:
            assoc_change = &notif->sn_assoc_change;
            printf("Assoc Change: state: %u, error: %u, instreams: %u "
                "outstreams: %u\n", assoc_change->sac_state, assoc_change-
                >sac_error,
                assoc_change->sac_inbound_streams, assoc_change->sac_
                outbound_streams);
            break;

        case SCTP_SEND_FAILED:
            send_failed = &notif->sn_send_failed;
            printf("Send Failed: len: %u err: %u\n", send_failed->ssf_length,
                send_failed->ssf_error);
            break;

        case SCTP_PEER_ADDR_CHANGE:
            addr_change = &notif->sn_paddr_change;
            if (addr_change->spc_addr.ss_family == AF_INET)
            {
                struct sockaddr_in *sin;

```

```

char addrbuf[INET6_ADDRSTRLEN];

sin = (struct sockaddr_in *)&addr_change->spc_addr;
const char *ap = inet_ntop(AF_INET, &sin->sin_addr,
    addrbuf, INET6_ADDRSTRLEN);

printf("Peer Addr Change: %s state: %d, error: %d\n", ap,
    addr_change->spc_state, addr_change->spc_error);
}
break;

case SCTP_REMOTE_ERROR:
    remote_error = &notif->sn_remote_error;
    printf("Remote Error: err: %u len: %u\n",
        ntohs(remote_error->sre_error), ntohs(remote_error->sre_length));
    break;

case SCTP_SHUTDOWN_EVENT:
    printf("Shutdown Event.\n");
    break;

default:
    printf("Unknow event type: %u\n", notif->sn_header.sn_type);
    break;
}
}

int main()
{
    int fd, new_fd, ret, len, msg_flags;

    struct sockaddr_in own, cli_addr;
    struct sctp_sndrcvinfo sri;

    char buffer[100]; /* To read/write data */

    /* Open socket. Note: IPPROTO_SCTP use */
    if ((fd = socket(AF_INET, SOCK_STREAM, IPPROTO_SCTP)) == -1)
    {
        perror("socket");
        exit(1);
    }

    own.sin_family = AF_INET;
    own.sin_port = htons(2809); /* Some available port */
    own.sin_addr.s_addr = INADDR_ANY;
    if (bind(fd, (struct sockaddr *)&own, sizeof(own)) == -1)
    {
        perror("bind");
        exit(1);
    }

    if (listen(fd, 1) < 0)
    {
        perror("listen");
        exit(1);
    }

    /* Enable all events */
    struct sctp_event_subscribe event;
    event.sctp_data_io_event = 1;
    event.sctp_association_event = 1;
    event.sctp_address_event = 1;
    event.sctp_send_failure_event = 1;
    event.sctp_peer_error_event = 1;
    event.sctp_shutdown_event = 1;
    event.sctp_partial_delivery_event = 1;
    event.sctp_adaption_layer_event = 1;

    while(1)
    {
        new_fd = accept(fd, (struct sockaddr *)&cli_addr, (socklen_t *)&len);
        if (new_fd > 0)
        {
            printf("\nNew connection from: %s\n", inet_ntoa(cli_addr.sin_addr));
        }

        /* Subscribe to events */
        if (setsockopt(new_fd, IPPROTO_SCTP, SCTP_EVENTS, &event, sizeof(event)) != 0)
        {
            perror("setsockopt");
            return (-1);
        }

        /* Receive msg from client */
        memset(buffer, 0x0, sizeof(buffer));
        ret = sctp_rcvmsg(new_fd, buffer, sizeof(buffer),
            (sockaddr *)&cli_addr, (socklen_t *)&len, &sri, &msg_flags);
        if (ret < 0)
        {
            perror("sctp_rcvmsg");
            continue;
        }

        /* Handle events, if any */
        if (msg_flags & MSG_NOTIFICATION)
        {
            handle_event(buffer);
            continue;
        }

        printf("Received %s on stream no %d\n", buffer, sri.sinfo_stream);

        /* Echo back received data */
        len = sizeof(cli_addr);
        ret = sctp_sndmsg(new_fd, buffer, ret, (sockaddr *)&cli_addr,
            len, 0, 0, sri.sinfo_stream, 0, 0);
        if (ret < 0)
        {
            perror("sctp_sndmsg");
        }
        else
        {
            {

```



```

        printf("Sent %s to client\n", buffer);
    }

    /* Initiate SHUTDOWN sequence. Use SO_LINGER
     * socket option (via setsockopt) to send ABORTs
     */
    close(new_fd);
}
}

```

And here's the code for *client.c*:

```

#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include <unistd.h>

#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <arpa/inet.h>
#include <sctp.h>

int main()
{
    int sock_fd, ret, len, msg_flags;

    struct sockaddr_in serv_addr;
    struct sctp_event_subscribe event;
    struct sctp_sndrcvinfo sri;

    char buf[256];

    serv_addr.sin_family = AF_INET;
    serv_addr.sin_port = htons (2000);
    serv_addr.sin_addr.s_addr = inet_addr("127.0.0.1");

    sock_fd = socket (AF_INET, SOCK_STREAM, IPPROTO_SCTP);
    if (-1 == sock_fd)
    {
        perror("socket");
        exit(1);
    }

    if (connect (sock_fd, (struct sockaddr *) &serv_addr,
        sizeof(serv_addr)) < 0)
    {
        perror("connect");
        exit(1);
    }
    else
    {
        printf ("Connected to [%s]\n", inet_ntoa(serv_addr.sin_addr));
    }

    /* Not subscribing for any events. Not interested. */

```

```

memset (&event, 0, sizeof(event));
if (setsockopt(sock_fd, IPPROTO_SCTP, SCTP_EVENTS, &event, sizeof(event)) != 0)
{
    perror("setsockopt");
    return (-1);
}

sri.sinfo_stream = 1; /* Send data on stream no 1 */

/* Prepare data to be sent to server */
memset (buf, 0, sizeof(buf));
strcpy(buf, "Hello, SCTP world!");
ret = strlen(buf);

/* Send data to server */
len = sizeof(serv_addr);
ret = sctp_sendmsg (sock_fd, buf, ret, (sockaddr*)&serv_addr, len, 0, 0,
sri.sinfo_stream, 0, 0);
if (ret < 0)
{
    perror("sctp_sendmsg");
    return (-1);
}
else
{
    printf("Sent %s to server\n", buf);
}

/* Receive what server sends back */
ret = sctp_rcvmsg (sock_fd, buf, sizeof(buf), 0, 0, &sri, &msg_flags);
if (ret < 0)
{
    perror("sctp_rcvmsg");
}

printf ("Received message from server on stream %d: %s\n", sri.sinfo_stream, buf);


close (sock_fd);

return 0;
}

```

I hope walking you through this simple client-server program gives you an idea about the virtues of SCTP.

Further reading

- Man pages: <http://linux.die.net/man/7/sctp>
- SCTP specific structure details:
<http://www.kernel-api.org> 

By: [Srikanta Prasanna](#).

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An Auto Company Zips Along the Fast Lane with FOSS

Carnation Auto, a multi-brand auto sales and service company, has grown phenomenally after opting for an open source enterprise platform.

*S*tarted in March 2009, Carnation Auto—a multi-brand automobile sales and services network set up by the former MD of Maruti Suzuki, Jagdish Khattar—offers car owners a wide array of services covering servicing, mechanical repairs, body repairs, accessories, insurance, pre-owned cars, car customisation solutions, etc. From rectifying scratches and bumps, to transforming off-the-assembly-line cars into one-of-a-kind attention-grabbers with accessories, Carnation has grown to 15 hubs across 10 cities, with more than 700 employees—all in a matter of nine months.

This accelerated growth wouldn't have been possible without open source technology. The firm adopted Red Hat Enterprise Linux Advanced Platform to run its business critical SAP ERP suite. The open source platform additionally helped it achieve integrated virtualisation on the HP ProLiant BL460c G6 server.

“When we started operations in 2009, we wanted to offer the customer a wide array of six to seven services, including mechanical servicing, body and paint work, CNG/LPG retro fitments, customisation, accessories, financing and insurance. To ensure a



consistent and high-quality customer experience, we needed seamless automation but at a low cost. An accelerated rollout and rapid scalability of our services was critical for early success. Thus, we chose Red Hat Enterprise Linux Advanced Platform,” says Mohit Agarwal, chief information officer, Carnation Auto.

Open source gear

Implementing open source technology was not easy. The intensive lifecycle management that Carnation wished to provide to its customers demanded a centralised IT system that would be a single window to address the various needs of multiple stakeholders (customers, business partners and employees). For this, the company chose the SAP business suite.

The simplicity in managing the infrastructure, scalability and performance compatibility of the SAP business suite and HP ProLiant servers, coupled with low cost solutions, led to the decision to go for open source technology.

“We considered a number of operating systems as the platform for our business-critical SAP applications, and selected Red Hat Enterprise Linux Advanced Platform because it provided the best overall value, stability and performance,” says Agarwal.

On the fast track

There has been no looking back since then. Open source technology helped Carnation reduce costs, improve the performance of the IT infrastructure and achieve scalability, thereby propelling the firm onto the fast track.

Carnation Auto went live with SAP about four months back and has achieved a good performance from SAP’s business suite atop Linux. Today, the firm has 15 live sites,

with 400 users. So far, it has used only 10 per cent of its server capacity.

“We are a distributed business. The final performance of SAP depends on multiple factors, of which one is the platform. With open source, we haven’t had any performance issues despite the number of users increasing to 400 today. Not an hour of user productivity in terms of system downtime has been lost ever since we implemented the solution,” testifies Agarwal.

Response time is also critical to a system that is partly exposed to customers, as any performance delay would adversely affect the customers’ confidence in the solution.

“For our customers, the Carnation experience should never be denied. Linux allows the SAP business suite to aggregate information across domains, and it enables a customer-facing front-end that performs like a retail operation,” adds Agarwal.

SAP’s commitment to Linux as a long-term strategic and supported platform for customers worldwide also assured Carnation a solution with end-to-end support—from the hardware to the OS, and through to the business applications.

Further, Linux is highly scalable, which complements Carnation’s growth plans. “We wish to open 100 hubs in the next three years and increase our user base on SAP to over 3,000 users. We are confident of Linux having the ability to help us achieve such scalability. Today, we can see ourselves grow ten times on the same platform without any issues, with

“We are looking at over 30 per cent cost savings from IT investments in Red Hat solutions over the next five years.”

—Mohit Agarwal, chief information officer, Carnation Auto



Linux guiding our vision of transforming the automobile industry," says Agarwal.

Low on cost

Open source technology was also easy on the pocket for Carnation. A large portion of the cost savings resulted from the elimination of exaggerated software licensing fees. "Our estimates show that cost benefits are likely to exceed 50 per cent compared to proprietary platforms," said Agarwal.

Further, Carnation hopes to achieve a lower total cost of ownership through open source because security is inherent to the platform (and not additional licensing baggage), aided by quick deployment that is crucial for a business where time is money. "We are looking at over 30 per cent cost savings from IT investments in Red Hat solutions over the next five years," says Agarwal.

Many critics, however, might claim that maintenance costs of an open source platform might squash these dreams. But Carnation's experience of a customer facing an enterprise system on the Linux platform speaks otherwise.


"By opting for Tata Consultancy Services (TCS) to provide end-to-end system integration services through a multi-year agreement for an enterprise IT solution, we ensured no hitches in the maintenance of our IT system. We have raised a couple of tickets but there have been no major hitches so far," says Agarwal.

Additionally, RHEL Advanced Platform with integrated virtualisation enabled Carnation to quickly virtualise servers for testing and development, and try new features in-house before deploying them on customer-facing applications. "The open source platform allowed us to increase the utilisation of servers without increasing the number of servers to be deployed. Red Hat came with the ability to move within virtual machines, on-the-fly, without any performance deterioration," says Agarwal.

"The compatibility of SAP with Red Hat, and Red Hat with the HP servers, worked very well for us. It helped meet the increasing demands of the business, enhanced process efficiencies, and led to rapid growth," he adds.

The road ahead!

Looking ahead, Carnation hopes to deploy open source on its existing desktops. "We have about 20 desktops per hub. We are looking at an open source desktop platform in these hubs in about a year. We are looking at tremendous cost savings, and the easy management of front-end users' systems, which are like points of sale," quips Agarwal.

It sure is life on the fast lane for Carnation! 

By: **Vanisha Joseph**

The author loves to experiment and writing for LINUX For You is her latest experiment. So, beware! Just a minute, she also happens to be a journalist during the day.

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A Training Institution that's Going Places, while Breaking New Ground!

By targeting students from distant shores, a training and certification institution has created a lucrative offshore travel-cum-training certification business that could be the forerunner of a BPO-scale industry!

*V*ision is perhaps our greatest strength... it makes us peer into the future and lends shape to the unknown."—Li Ka Shing, a businessman from Hong Kong

The story behind how the founder of Koenig Solutions came up with a radical business model, to turn a struggling training and certification institution into a profit churning multi-city entity, may interest many existing or wannabe entrepreneurs.

In 2000, when the dotcom bust hit the IT industry, entrepreneurs running the IT training and certification businesses also felt the heat. The options were either to quit and save themselves from further losses; or to tie a knot at the end of the rope, hang in there, and look

for opportunities in the middle of the crisis.

Rohit Aggarwal, founder of Koenig Solutions, chose the second option and decided to not only stand firm in the face of this onslaught but also emerge out of it stronger. Driven by his vision to make a success out of his hard-hit IT training certification business, he decided to explore new options and innovate around the existing set of resources.

Supported by a team of dedicated professionals, including the current general manager, Sandeep Dhawan, he decided to downsize and focus only on the profitable niches. On analysis, the team discovered that, occasionally, foreign students attended courses at Koenig. The company saw an opportunity to make extra bucks by bundling travel and hospitality with its core teaching and training offerings.

The turning point

This was an experiment that worked well for Koenig. The team bundled a hotel tariff in the course fee, and began making money on commissions from the hotel where the students would stay. "Although it was a miserly sum of Rs 200 per day, it seemed like a princely sum to us in those days," recalls Aggarwal. The first student who opted for this course-plus-hotel package came from the UK in 2002. "He was happy with our solution and agreed to become our referral in the UK. This encouraged us. Foreign students started coming in regularly, albeit in small numbers. Since these students saved a lot of money compared to training in their own country, they were quite happy," he adds.

At that time the team felt that if the institution could get 10 students every month, it would be a great achievement. This target was achieved in 2004. "Soon the true potential of offshore training started to dawn on us. We set a target of 100 students per month, which we achieved in 2009. We are now targeting 1,000 per month, which is to be achieved in the next few years," shares Aggarwal.

Blending tourism with training

Initially, Koenig's business idea was to save costs for its customers. Tourism was not a significant aspect of its value proposition. But in 2004, based on the feedback received from its customers, who liked this unique blend of tourism and study, it decided to strengthen this aspect.

Going forward, some students remarked that Delhi was not the ideal place to study because of its traffic, noise and summer heat. This prompted the team to open a centre in Shimla. Then another centre came up in Goa, in 2005.

Talking about the key factor that has helped shape the Koenig growth story, Aggarwal says: "The success of our business depends upon ensuring that our customers have a hassle-free stay in India. We have developed strong relationships with reliable and customer-oriented vendors and hotels in India, and most of our customers recommend India as a tourist destination to their friends and colleagues."

Surmounting challenges

But success didn't come easy to the team. Aggarwal recapitulates those days when, compared to western standards, the institution's infrastructure and facilities were ramshackle, with even computers being obsolete. But there were a few things that kept Koenig ticking. "The trainers and staff kept going with full motivation. The students liked the concept of the 'one-on-one' training that was imparted, and also the abundant attention that they received from the administrative staff."

Over the years, Koenig improved its services. "The facilities and computers became state-of-the-art and comparable to the best in the world," says Aggarwal.

A business model that may grow, dramatically!

Offshore training is a novel business idea that Koenig has pioneered in India, claims Aggarwal. He feels that the concept

FOSS certifications: Trend-spotting

Since Koenig Solutions has been in the business of FOSS and Linux certifications and training for over 15 years, we requested Aggarwal to share a few details regarding the demand that exists in this domain, and the factors that are propelling this demand.


Aggarwal observes that there is a growing demand for FOSS skills. "Keeping this trend in view, we have progressively increased our training portfolio for FOSS and we plan to further enhance it in the coming year (e.g., with Zend PHP certification)." RHCE remains the most sought-after certification in FOSS. LPI certification (which is now supported by Novell) is also gaining popularity, besides MySQL/PHP skills, which are also in demand, he adds.

"We have been offering training on Red Hat Linux since 2004. As of today, we also offer training on Novell (SUSE) Linux, Solaris, Ubuntu, LAMP (Linux, Apache, MySQL, PHP) and LPI certifications. Our training and certification on Linux and open source technologies has been growing by 50 per cent, year-on-year, and we expect this trajectory to continue."

has the potential of evolving into a full-fledged industry. He explains: "We are diverting clients from other countries to India and, in the years to come, this will be another business on par with today's call centres, BPOs and other ITES (IT-enabled services)."

Aggarwal takes pride in several other innovations that Koenig has come up with over time. "The concept of 'one-on-one' training and the holiday-cum-training are the key innovations. Apart from this, we constantly upgrade our facilities and innovate in the HR processes (which are critical to retain the best IT talent) to meet international standards. In fact, as of today, our students prefer Koenig primarily because of quality. Cost is a secondary consideration."

For budding entrepreneurs who wish to set up a training and certification business, Aggarwal has a few words of advice: "Focus on quality. Far too soon, service providers fall into the trap of seeking short-term profits, thus compromising on the quality of their core offerings. Though there is no dearth of training providers, there is a virtual vacuum for businesses that deliver superior quality that's beyond their price point. So businesses that are paranoid about quality will always do well."

"A service provider determined to 'wow' the customer and continuously innovate to meet the customers' latent needs cannot but be successful in the long run," he asserts. And, we agree! 

By: Vandana Sharma

The author is an assistant editor at the EFY Group. Apart from writing on subjects like entrepreneurship, IT for businesses, she loves to read on a range of topics, which include religion and spirituality. She likes to read 'meaningful' fiction, too.



A Roundup on Microblogging Clients

We brief you on the options—just take your pick.

The latest buzz in social networking is microblogging—the next generation of blogging where people share their status, images, audio and video files with their friends without being verbose. When you microblog, you answer one simple question: “What’s happening?”

Some of us are already into microblogging, without quite realising that there is a term for the small text we enter in our IM clients and elsewhere to publish our status. And some of us are microblog addicts, already!

Many full-fledged social networking sites

like Facebook, Orkut, LinkedIn, etc, provide ways to microblog, though they’re all referred to by different names, such as ‘Updates’, ‘Status Update’, etc. There are also dedicated sites just for microblogging, like identi.ca, twitter.com, tumblr.com, present.ly, yammer.com and many more.

Many of us are comfortable microblogging using the service provider’s website, while others prefer desktop applications to satisfy their needs.

Before we plunge into the different clients that exist for microblogging in GNU/Linux systems, let’s understand some microblogging terminology, with respect to the services

provided by popular sites such as Twitter and identi.ca:

- **follow** – Anyone can follow any user. Users who are being followed can control whether or not someone can follow them.
- **tweet** – To tweet is to post a small text message of 140 characters or less in your account, which is usually related to what's happening in your life. Many companies and individuals also tweet to market or advertise products, or simply share updates.
- **timeline** – This refers to a user's tweets.
- **Re-tweet** – This is all about spreading the word. Just as you forward an interesting email to your friends, you can re-tweet someone else's tweet so that your followers also get the update.
- **direct messages (DM)** – This is like sending a private message to someone and only works if the person is following you.
- **URL shortener** – URLs are generally long. And since tweets can't be longer than 140 characters, you don't want to waste character space by sharing a long URL. This is where URL shortening services like tinyurl.com, bit.ly, is.gd, etc, come handy. With their help you can convert a 50-character URL to less than 10 characters.

With all that jargon from twitter-land out of our way, let's start exploring the various clients available for tweeting from our desktops in a GNU/Linux system. Ranging from raw APIs to impressive-looking GUI, there are plenty of clients available for tweeting. In fact, if you are a Python developer, it won't take much time to roll out your own twitter client!

Gwibber

Developed using Python and GTK+, Gwibber targets GNOME users. The initial development was started by the Ubuntu community, but over time, it's been available on most distros. It supports a number of services such as Twitter, Identi.ca, Laconica, FriendFeed, Facebook, Jaiku, Digg, Flickr, BrightKite, Kaiku and even has experimental support for OpenCollaboration. Naturally, it supports multiple-account configuration with these different services, simultaneously.

The setting up of accounts is straightforward. The user interface looks similar to an e-mail client in some senses, where different accounts and the related items are grouped together. The menus are simple enough and self-explanatory. And the best part is that almost everything you want from a microblogging client is available.

You can differentiate tweets from different microblogging services by assigning colours to each service, as you can see in Figure 1. Here, all tweets from Twitter have a light blue colour strip, and those from identi.ca have a light green strip. This is very handy when using multiple accounts from different microblogging service providers.

Just like your IM client, you can choose whether to minimise to tray or close Gwibber, on clicking the X. It also shows notification bubbles when new tweets arrive. Another good feature is the URL shortener support, which is still experimental at the time of this writing. Some URL shortener services you can



Figure 1: Gwibber is the first choice for GNOME users

choose from are cli.gs, is.gd, tinyurl.com, tr.im and ur1.ca.

Re-tweeting and replying is a piece of cake. In fact, tweeting/re-tweeting an update to multiple accounts is also possible. Besides, it gives you fine grained control when choosing the time interval (in minutes) for auto-refreshing the timelines—either by typing the value or by sliding through the combo box. What else? The search interface helps you search for tweets.

Finally, support for themes means you can choose from a range of available themes or write one on your own to fit your desktop's look and feel.

Twitux

Twitux is another GTK+ based Twitter client that targets GNOME users. It has a very simple user interface that displays the timelines of those you follow. The best part is that it's very easy to use.

There is a way to filter the timelines. Some of the different timeline views available are *public*, *friends*, *my*, *twitux*, *direct messages*, *direct replies*, etc. Apart from these generic timeline views, it also has a menu item called 'Friends' in which all the users whom you follow are listed, which provides a way to filter and view an individual's timeline.

GNOME integration is quite decent—the GNOME notifier updates you on new tweets, and GNOME Keyring manages authentication credentials. Other features available in twitux are:

- Expanding messages
- Switching between showing the user name and real name
- Retrieval intervals can be configured (3, 5, 15, 30, 60 minutes)
- The manual refresh of tweets
- A spell checker for your tweets
- Adding friends
- Sending direct messages
- Storing credentials and connecting automatically
- Sound notifications when a message is received



Figure 2: Twitux has a basic UI

On the downside, Twitux only supports one Twitter account at a time. So, if you use multiple accounts and want a single client to manage them all, Twitux won't fit the bill. Besides, it doesn't have support features like viewing a user's profile, re-tweeting, replying to messages and URL shortening.

gTwitter

gTwitter is yet another GTK+ based client which is still under development and supports only Twitter. Its GUI is inspired by the Mac client twitterrific (see <http://iconfactory.com/software/twitterrific/>). It runs like a GNOME applet where once the application is closed, it minimises to the desktop panel.

You can configure your Twitter account by right clicking the desktop panel icon and selecting the *Preferences* option. There are two views—a tweet view and a list view. Figure 3 shows the list view.

gTwitter allows you to watch the timelines of both your friends and the public. It caches the user profile pictures locally and displays it alongside a friend's tweets. You can configure the refresh interval between 1 and 30 minutes. Manual refresh is also possible. There is still a long way to go for gTwitter and only those who want a simple GUI to post on Twitter should try this.



Figure 3: gTwitter only supports Twitter

Qwit

Guess all you KDE folks are getting worried? Well, fear not, because there's a Qt4-based client called Qwit too. It supports Twitter, identi.ca and some other custom microblogging services like Laconica. Its user interface is simple and self-explanatory. The UI has tabs located on the left side of the app window vertically, in order to watch public/friends' timelines. The search functionality is included there. In fact, you can customise the UI according to your needs. If you are behind a proxy, then Qwit gives the required interface in order to configure your proxy settings too.

It supports multiple account configurations. URL shortening is also integrated and you can choose from either `tr.im` or `murl.kz`. Qwit is specific on how connections are made to the online services—that is, `http://` or `https://`. This is something I haven't even found in Gwibber.

One big disadvantage here is that you do not have control



Figure 4: Qwit's innovative interface

over the time interval to refresh the timelines. You can either configure it to auto-refresh or not to refresh. Thankfully, there's a sync icon which you can use in case you are not satisfied with the time interval for automatic refresh.

Choqok

This one is the icing on the cake for KDE users. It currently supports Twitter, identi.ca and custom Laconica-based services.

Unlike Qwit, Choqok is tightly integrated with KDE. It uses KWallet for storing user credentials and new tweet notifications are made using the Knotify (although, it has support for libnotify also).

Choqok has almost all the features you'll expect, with a very pleasing and easy-to-use UI. You can configure multiple accounts, and when you do, each account occupies a separate tab horizontally on top. There's a very cool feature in the list box that lists all your followers whom you can DM.

Just like the Web interface, when we mouse over any tweet, small icons appear for deleting, adding to favourites or re-tweeting messages! Choqok supports URL shortening with services like `is.gd`, `2tu.us` and `digg.com`. Of course, there's an option to search public timelines.

Besides, it's even integrated with `twitpic.com`, which is Twitter's cousin for posting picture updates quickly. Another interesting feature is its integration with Amarok—hit `Ctrl+L` and tweet what you're currently listening to instantly, without keying in any character. Overall, it is fairly feature-rich, and a mature enough client for all KDE users.



Figure 5: Choqok is #1 for KDE4 users

BTI

All you command-line addicts must be wondering what's out there for you. Well, there's BTI, which is written in C, and supports identi.ca and Twitter. Unlike the two we discussed earlier, this one isn't a full-fledged application. What it does is "allow you to pipe your bash input to Twitter or identi.ca in an easy and fast manner to annoy the whole world."

A sample run in the command line follows:

```
stylese@vanji:~$ bti --version
bti - version 0.23
stylese@vanji:~$ bti --host twitter
Enter twitter account: testse
Enter twitter password: mypassword
tweet: This is a test tweet from #bti client.
stylese@vanji:~$ bti --host twitter
Enter twitter account: testse
```




Figure 6: Twitter.com screenshot shows the tweets from BTI

```
Enter twitter password: mypassword
tweet: This is a test tweet from bti client.
```

As you can see in the snippet above, the password is not blanked out, which we generally expect from any other command line utility. I hope they fix it in future releases.

BTI also supports a configuration file. You can place a `.bti` file in your home directory (`~/.bti`), which looks like the following:

```
# comments are allowed in the bti config file
account=twitmaster
password=mypassword
host=identica
# Example of a custom Iaconica installation
#host=http://army.twit.tv/api/statuses
logfile=.bti.log
#action=update
#user=gregkh
#proxy=http://localhost:8080
#shrink-urls=yes
```

This saves you from typing your credentials every time you want to use a service.

It has many command line options for tweeting. For example, you can shorten a URL using the `—shrink-urls` option. A shell script called `bti-shrink-urls` takes care of the shortening business.

```
tweet: This is a test tweet to test URL shortening http://www.google.com/
search?q=styleesen&ie=utf-8&oe=utf-8&aq=t&rls=org.debian:en-US:unofficial&cl
ient=iceweasel-a
```

Figure 6 shows the tweets from Twitter.com that we've posted using BTI. Anyway, there's not much you can do using BTI besides posting your updates.

Twidge

Twidge is another command line client and supports identi.ca and Twitter. It can be used in an automated way to post to the services, and can also be interactive. Twidge is easy to use and it's highly customisable to fit your needs as well.

It is mandatory to have the `'twidgerc'` file in your home folder, in order to use this app. Twidge can create `'~/.twidgerc'` automatically when you run `twidge setup` by interactively asking questions about your account:

```
styleesen@vanji:~$ twidge setup
Welcome to twidge. We will now configure twidge for your
use. This will be quick and easy!
```



Figure 7: Twitter.com screenshot shows the tweets from Twidge

```
First, what is your username?
Username: testsen
Welcome, testsen! Now I'll need your password.
Password:
twidge has now been configured for you.
```

There are lots of configuration parameters that could go into the configuration file. All of these are available in the man pages or you can get the manual from <http://software.complete.org/static/twidge/doc/twidge.pdf>. A simple sample configuration file for Twidge is as follows:

```
[DEFAULT]
password: mypassword
username: testsen
```


A sample run to post on Twitter follows:

```
styleesen@vanji:~$ twidge update "This is a test tweet from
@twidge client."
styleesen@vanji:~$ twidge update "This is a test for
URL shortening from @twidge http://www.google.com/
search?styleesen&ie=utf-8&oe=utf-8&aq=t&rls=org.debian:en-US:
unofficial&client=iceweasel-a
styleesen@vanji:~$
```

Figure 7 shows the posted tweets from Twitter.com.

It supports URL shortening with `tinyurl.com`. You can integrate it with your email system in order to send and receive updates in the form of emails. With the `dmsend` option, it is possible to send direct messages too.

Postscript

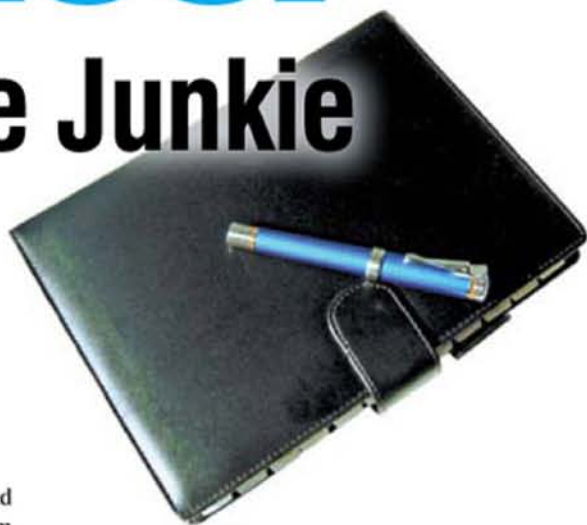
Of course, this article does not give an entire list of all desktop clients available for microblogging—my purpose was to just discuss some of those I've used. In fact, all you Pidgin users might not need a separate app for microblogging—the 'micro-blog purple' plug-in can be good fun. Likewise, you can install the Echofon Firefox extension also. And well, it doesn't stop there. If you know Python, you can cook up your own client with the 'Python-Twitter' module. Happy microblogging! 

By: Senthil Kumaran S.

The author is currently employed by CollabNet, working for its Version Control Group. He is a full committer of the Subversion project and is a free software enthusiast. To know more, visit www.styleesen.org.

The Ultimate Organiser for the Console Junkie

Introducing Calcurse, a text-based organiser that can work as your personal assistant.



*H*ave you ever forgotten an important meeting? Or missed the latest episode of *Lost*? I'm sure it's happened to some of you.

Juggling tasks is difficult, so instead of trying to keep track of every important thing either in your head or on a piece of paper, why not give computer-based organisers a try? There are many organiser applications available on the Linux platform, and they're called Personal Information Managers (PIM). People are mostly familiar with Korganizer and Sunbird as power-packed PIMs. They are very good, no doubt, but are not the only good applications available in the open source world.

Graphical tools, though intuitive, are often resource hungry. I am sure many of us would prefer solutions with much less resource requirements, yet with an easy and intuitive interface. This is where Calcurse comes into the picture. Calcurse is a text-based calendar and scheduling program with loads of features. The name Calcurse is derived from 'calendar + ncurses'. You guessed right; it has an ncurses-based interface—which makes it very easy to use.

What is Calcurse?

By using Calcurse you can keep track of your daily tasks, appointments and events. You can also set notifications to tasks, as and when required, and sort the tasks by priority. You can even tag the entries with notes. There is an option to change the colour scheme, change the layout and also change the key-bindings right from the application itself. You don't even need to edit the configuration files externally, manually. With many additional features like the import and export of the iCal format calendar (Google calendar uses this), auto-save, the ability to run in the background as a daemon, this organiser is one of the best I have ever come across.

An overview

Calcurse can operate in three modes. The first is the non-interactive mode, where you have to pass arguments to the program and get the output on the terminal. The second interactive



Figure 4: Settings view

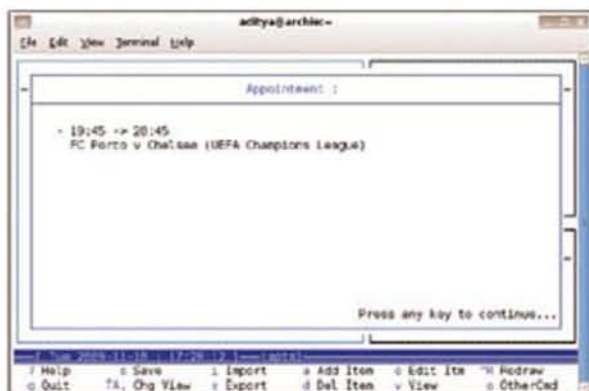


Figure 5: Detailed view of an appointment

In order to set the notifications, go to the Notify sub-menu. Here you can choose whether to display the notification bar or not, and which information to display. The important setting here is the `notify-bar_command` and `notify-bar_warning`. The `notify-bar_command` is executed `notify-bar_warning` seconds before a flagged appointment. To flag an appointment, highlight the appointment and then press '!'. It will be marked as 'important' and the `notify-bar_command` will be executed before this appointment.

Inside the Colour sub-menu, you can change the default colour scheme. The key-bindings sub-menu lists all possible keys and their functions, which can be changed according to your need. The Layout sub-menu allows you to choose between eight predefined layouts for arranging the three windows (appointments, calendar and tasks) inside the terminal.

Import and export

This feature is by far the best feature of this application. You can export your entire calendar in iCal or Pcal format. And this can then be imported to other organisers. The import function can be used to import iCal format calendars. Currently, the import function cannot import the notifications set in the iCal format; it also cannot import the notes. This is a serious flaw, but it's in line for correction in the next update.

Multiple calendars?

It is possible to have multiple calendars using Calcurse. The default Calcurse files are created in the home directory of the user inside the `.calcurse` directory. The files are:


- `notes/` – This directory saves the notes created with the appointments and tasks.
- `conf` – This file contains the configuration settings of Calcurse.
- `keys` – This file contains the key-bindings of Calcurse.
- `apts` – This file contains the appointments.
- `todo` – This file contains the to-do (tasks) list.

As you can see, the task and appointment files are different. By simply changing the appointments file, we can have a different calendar entry, keeping the tasks constant. To change Calcurse to a new calendar, open Calcurse with an argument `-c`, that is:

```
calcurse -c PathOfTheCalendarDatabaseFile
```

And the events and appointments from this file will be available with you.

The verdict

Certainly Calcurse is not the best organiser in the world. The obvious glitches in the import function and lack of mouse support are serious problems. However, with its size being less than half a megabyte and the memory requirement also less than 16 MB, this is a gem for people with older hardware. **END** 

By: Aditya Shevade

National Talent Scholar, Aditya Shevade, a final year electronics engineering student, takes keen interest in programming and electronic design. A Linux user for more than three years, he enjoys playing the keyboard and is a good photographer. To know more about him, visit www.adityashevade.com

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CODECHEF

The CodeChef.com Challenge—your monthly dose of coding puzzles from India's biggest coding contest, now in print!

Welcome back to the CodeChef Puzzle Challenge, sponsored by LINUX For You and Directi. It's time to take a look at another one of CodeChef's interesting problems for March, and while you're at it, let's see if you can win some cash as well!

Last month's puzzle

The Fibonacci number series is a famous one where $F[n] = F[n-1] + F[n-2]$. The first few numbers of this series are 0, 1, 1, 2, 3, 5, 8, and so on. Considering 1-based indices, what is the 999th Fibonacci number? (For example, The 7th Fibonacci number is 8).

The solution

Considering 1 based indices the 999th Fibonacci number is:
 16602747662452097049541800472897
 70183494805119838482806235855309
 1918573717701170201065510185595
 8986051040947369188792784622330
 159810295229978363112326187605
 391990367653997999267314332397
 18860373345088375054249

How did we do it?

This number can be calculated

by using big-integer libraries provided by some languages like Java, or by using a language like Python that supports large calculations natively. You can also write code for this in C/C++ by using arrays to store the numbers.

And the winners for February are...

- Srinath Krishnan
- Balakrishnan Erode
- Aaliya.Ash


Puzzle for March

Four distinct balls can be partitioned into three non-empty subsets in an unordered manner as follows.

{(1), (2), (3,4)}
 {(1,2), (3), (4)}
 {(1), (2,3), (4)}
 {(1,4), (2), (3)}
 {(1,3), (2), (4)}
 {(2,4), (1), (3)}

We see that there are six ways of partitioning the four balls. In how many ways can we partition five such balls into three non-empty subsets?

Would you like to get a little extra cash?

Then solve this month's CodeChef Challenge puzzle and mail your answer to codechef@efyindia.com by March 18, 2010. Three lucky winners will win cash of Rs 1,000 each! 

About CodeChef: CodeChef.com is India's first, non-commercial, online programming competition, featuring monthly contests in more than 35 different programming languages. CodeChef has been created by Directi, as a way to continuously challenge and engage the developer community. The goal is to provide a platform for practice, competition and improvement as well as enable developers to benchmark their skills against their peers. Log on to www.codechef.com for the next monthly challenge that takes place from March 1-11, 2010, and win cash prizes worth Rs.55,000.

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Getting Started with OpenLDAP

Part 2

Adding Basic Security Measures



Let's get started on adding the initial level of security to OpenLDAP servers.

In the last article, we had set up a basic OpenLDAP server and populated it with data. We had also searched the directories anonymously and seen that we could not add entries (write data to the directory) anonymously. This is because of the default security policy in *slapd.conf*, the LDAP daemon configuration file. In this article, we will take a look at adding an initial level of security to OpenLDAP servers.

The first and the foremost line of defence in any *nix operating system are the file and folder permissions. You must ensure that the server configuration */etc/openldap/slapd.conf* file has 640 permissions and 'root:ldap' are the user and group owners, respectively, as shown below:

```
[vbg@vbg ~]$ ll /etc/openldap/slapd.conf
-rw-r----- 1 root ldap 3729 Jan 29 11:05 /etc/openldap/slapd.conf
[vbg@vbg ~]
```

Besides, ideally, the openLDAP rootDN

password must be encrypted rather than remain in plain text. In the last article, we had specified a plain-text password for the rootDN, as is evident from the terminal output below:

```
[root@vbg ~]# cat /etc/openldap/slapd.conf | grep rootpw
rootpw FOSTERInLinux
[root@vbg ~]#
```

As a security measure, this should also be encrypted. To encrypt the root password, we use the *slappasswd* command:

```
[root@vbg ~]# slappasswd -s FOSTERInLinux
{SSHA}gK7E8xSkbl4Bt42hZQzMG33HbUzFA4
[root@vbg ~]#
```

As can be seen above, SSHA encryption is the default encryption mechanism. You can also change the encryption algorithm to crypt or md5, but SSHA is the preferred scheme.

We can now add this encrypted password

to *slapd.conf* to further protect the rootDN password. Edit */etc/openldap/slapd.conf* and set the encrypted password as follows:

```
[root@vbg ~]# cat /etc/openldap/slapd.conf | grep rootpw
rootpw {SSHA}gX7E8aXSkbl14Bt42nZQzMG33HbUZF4A
[root@vbg ~]#
```

...and restart the *ldap* service:

```
[root@vbg ~]# /etc/init.d/ldap restart
Stopping slapd: [ OK ]
config file testing succeeded [ OK ]
Starting slapd: [ OK ]
[root@vbg ~]#
```

How would you test whether the new password is working or not? Do we have to always write something to the directory and check the password?

An easier and risk-free approach to the above would be to search the directory using a user name and password. The syntax for providing the userDN and password in the *ldapsearch* command is similar to that of the *ldapadd* command:

```
[vbg@vbg-work ~]$ ldapsearch -x -h 192.168.122.1 -b "dc=knafl,dc=org"
# extended LDIF
#
# LDAPv3
# base <dc=knafl,dc=org> with scope subtree
# filter: (objectclass=*)
# requesting: All
Anonymous Search works .....
```

Now let us try searching with a user name and an incorrect password:

```
[vbg@vbg-work ~]$ ldapsearch -x -h 192.168.122.1 -b "dc=knafl,dc=org" -D
"cn=Manager,dc=knafl,dc=org" -w xyz
ldap_bind: Invalid credentials (49)
```

This fails. Therefore, we know that the supplied credentials (user name/password) are incorrect.

To run a successful search, we will need to specify the correct password. That is left as an exercise for the reader.

Making successful authentication a prerequisite for successful search (disable anonymous directory read) is another security measure that I would recommend. Though this depends on the kind of data maintained in your directory, if you are unsure, it is best to disable anonymous read. This is done through 'access control instructions' in the configuration file.

But before we move on to 'access control restrictions', we first need to understand the structure of *slapd.conf*.

Why did I simply not append a line to the top of the configuration file specifying the encrypted password, above? It would have been very easy to demonstrate by mentioning

the following command, for instance:

```
[root@vbg ~]# MYPASS='slappasswd -s tr';sed -ie '1i/rootpw '$MYPASS'\`
/etc/openldap/slapd.conf
[root@vbg ~]# head -n 1 /etc/openldap/slapd.conf
rootpw {SSHA}LiHyBX3qZhd6I2ZpUjHrX74wFK1+1TF
[root@vbg ~]#
```

```
[root@vbg ~]# service ldap restart
Stopping slapd: [ OK ]
Checking configuration files for slapd: slaptest: bad configuration file!
[FAILED]
[root@vbg ~]#
```

So, we see that by randomly inserting lines, we are unable to set up the configuration file, *slapd.conf*. This can be achieved in some other configuration files though.

Now, if we delete the first line and add the same line to the bottom of the file, let us see what happens. Delete the first line:

```
[root@vbg ~]# sed -ie '1,1d' /etc/openldap/slapd.conf
```

Add the 'rootpw' to the bottom:

```
[root@vbg ~]# echo "rootpw 'slappasswd -s FOSTERinglinux'" >> /etc/openldap/
slapd.conf
```

This will add the encrypted root password to the configuration file, as demonstrated by the command below:

```
[root@vbg ~]# tail -n 1 /etc/openldap/slapd.conf
rootpw {SSHA}D1BMFFCG:HGR2AfazXN3IomZJqFkoIK1
[root@vbg ~]#
```

Now, let us restart the *ldap* service:

```
[root@vbg ~]# service ldap restart
Stopping slapd: [FAILED]
Checking configuration files for slapd: bdb_db_open: Warning - No DB_CONFIG
file found in directory /var/lib/ldap: (2)
Expect poor performance for suffix dc=knafl,dc=org.
config file testing succeeded
[ OK ]
Starting slapd: [ OK ]
[root@vbg ~]#
```

Obviously, we cannot insert 'rootpw' at the top of *slapd.conf*, but in the case of the default *slapd.conf*, we can do so at the bottom.

Why is it so? This is because *slapd.conf*, follows a certain structure. So let us ask ourselves: what is the need for a structure? One reason that I can think of is, backends.

OpenLDAP backends

Let's take a detailed look at backends in the later part of this series. It is the wide availability of backends that really

makes OpenLDAP such an exciting piece of software. OpenLDAP is very modular and can be thought of as having a frontend and a backend. The frontend basically is about the LDAP protocol, networking, etc, whereas the backend deals with the directory data storage.

At this point, it is sufficient to know that we can actually store data in an SQL database (MySQL, MS-SQL) and access that data through OpenLDAP using the 'sql' backend.

We can also create a proxy LDAP server, actually getting LDAP data from other servers using the 'meta' backend.

Normally, we use the Berkeley Data Base (bdb) backend with OpenLDAP servers, by default. The reasons and benefits for doing so can be explored in a subsequent article in this series.

It is this availability of backends and the possibility of using various backends together in a single instance of the OpenLDAP server that necessitates a prescribed structure for *slapd.conf*.

The default structure for *slapd.conf* as described in the man page (*man 5 slapd.conf*) is:

```
# comment - these options apply to every database
<global configuration options>
...
...
...
# first database definition & configuration options
database <backend 1 type>
..... <configuration options specific to backend 1>
..... <configuration options specific to backend 1>
..... <configuration options specific to backend 1>
# subsequent database definitions & configuration options
```

Global configuration options are defined at the top of *slapd.conf*. These options apply to all backends, unless explicitly overridden within a backend definition.

Databases are then defined by the keyword 'database'. Then database-specific options such as suffix, rootdn, rootpw, indexes, etc, are defined.

As we can see now, since we have only one database backend, specifying rootpw at the bottom of the file worked, as the rootpw is a database configuration option, but since it is not a global configuration option, specifying rootpw as the topmost line, failed.

Since *slapd.conf* requires a structured configuration, a utility called *slaptest* is included in the *openldap-servers* package. *slaptest* reads the configuration file and checks whether it is okay or not. We use the *-f* option to perform a sanity check on a configuration file:

```
[root@vbg ~]# slaptest -f /etc/openldap/slapd.conf
bdb_db_open: Warning - No DB_CONFIG file found in directory /var/lib/ldap:
(2)
Expect poor performance for suffix dc=knafl,dc=org.
config file testing succeeded
[root@vbg ~]#
```

Note: *slaptest* is a very useful and important tool, especially in production environments, where configuration changes and updates must be thoroughly tested before applying them.

Access control restrictions

Since this article focuses more on securing the OpenLDAP server, we go back to our discussion on access control restrictions. ACLs (access controls) in *slapd.conf* in their most simple form can be described by the following syntax:

```
access to [What] by [Who] [Permission]
```

As an example, the default access control restriction (when none is explicitly specified in the configuration file) is:

```
access to * by * read
```

By evaluating this syntax, it becomes:

- [What] => * (all parts of the directory)
- [Who] => * (all users - including anonymous)
- [Permission] => read

Thus the default access control restriction in *slapd.conf*, in plain English, means: "Allow all users to read all portions of the directory."

Can we allow anonymous writes into the directory as well? Let us test this by changing the access control restriction to: "Allow all users to write to all parts of the directory."

```
access to * by * write
```

Add this ACL to *slapd.conf* and restart the *ldap* service.

Let us also create a new address book entry, by the cn (common name) of 'lfy user'. A copy of the sample LDIF used in the first article of this series is given below:

```
[vbg@vbg-work ~]$ cat /tmp/lfy-user.ldif
dn:cn=lfy user,ou=addressbook,dc=knafl,dc=org
cn: lfy user
sn: user
l: Gurgaon
street: M-37, Old DLF Colony, Sector-14
st: Maryana
postalCode: 122003
homePhone: 0124 3333333
mobile: 0955555555
mail: info@fosteringlinux.com
objectClass: top
objectClass: inetOrgPerson
```

Let us now try to add this entry to the directory:

```
[vbg@vbg-work ~]$ ldapadd -x -h 192.168.122.1 -f /tmp/lfy-user.ldif
adding new entry "cn=lfy user,ou=addressbook,dc=knafl,dc=org"
ldap_add: Strong(er) authentication required (0)
additional info: modifications require authentication
```



```
[vbg@vbg-work ~]$
```

Surprisingly, our ACL did not work. Despite the fact that we specified any/all users to write to the directory, we were unable to do so. To enable anonymous writes (not at all recommended) to your directory, we will have to use another security directive—*allow*.

To enable anonymous updates to directory, add the following global configuration option to *slapd.conf*:

```
allow update_anon
```

Save the configuration file, check for errors in the configuration file, restart the *ldap* service and test whether you can add a user anonymously. This should succeed.

The *allow update_anon* option generally should not be enabled, as we do not want anyone to write data into our directory without authentication. It has some very special use cases that we might cover in the later part of this series.

Now, let us apply a more common security requirement to our LDAP server—disable anonymous access altogether. In other words, valid authentication will be required even for the *ldapsearch* command. How would we create that ACL?

```
access to * by anonymous none
```

The above ACL does not give any permissions to anonymous users. You can check whether the syntax of the ACL is correct or not, using the *slaptest* command discussed earlier.

But what are the possible permissions that can be specified in *slapd.conf*? We have already seen three of them: *read*, *write* and *none*. The others are: *disclose*, *auth*, *compare* and *search*. We will go into the details of each of these permissions later; we intuitively know the meaning of the other permissions—*read*, *write* and *none*.

Similarly, what are the possible values for 'who'? We have discussed two of these: *** (*all*) and *anonymous*. Two other possible values are: *users* and


self. *users* means entries or DNs that exist in the directory, and *self* means the user who is currently authenticated.

There are many possible values for 'what'. This depends on the directory data. In this article, we have only discussed *** as a possible value for 'what'. As we delve deeper into LDAP and understand attributes, objectclasses and schema, we will be able to better define the 'what' part of an ACL.

ACLs can also take more complex forms, including a 'control' option as per the security requirements of a directory. We will touch on these aspects once we create a central directory with users and passwords for authentication. For those of you who would like to experiment with ACLs right away and not wait for the upcoming articles, the man page for *slapd.access* is a storehouse of information:

```
[root@vbg ~]# man slapd.access
```

This page contains a wealth of information on *slapd.conf* access control options and is a must read when securing an LDAP server.

In the next article in this series, we will explore LDAP concepts such as schema, objectclasses and attributes, and build an LDAP server capable of authenticating Linux users. Do drop me a mail if you have any doubts or questions. The first article has elicited quite a few interesting responses—from questions to requests for certain advanced topics. I hope that we'll be able to cover most of them in the ongoing series. **END** 

By: Varad Gupta

Varad is an open source enthusiast who strongly believes in the open source collaborative model not only for technology but also for business. India's first RHCSS (Red Hat Certified Security Specialist), he has been involved in spreading open source through Keen & Able Computers Pvt Ltd, an open source systems integration company, and FOSTERING Linux, a FOSS training, education and research training centre. The author can be contacted at varad.gupta@fosteringlinux.com

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Part 9

The Art of Guard

Assigning Security Contexts to Subjects (Processes)

Understanding how subjects (or processes) that have been created in memory get their SELinux security contexts.

The previous article (Part 8) in this series covered type transition rules and explored how newly created files are allotted security contexts.

Files are stored in hard disks or permanent storage and, therefore, the security contexts are persistent across reboots. This article discusses security contexts for subjects (typically, processes) and how they are assigned.

To view the list of processes on your system, along with their hierarchy, use the *ps* command:

```
[root@vbg-work ~]# ps tree
init--NetworkManager--dhclient
|
|   {NetworkManager}
|   |
|   |   -abrtid
|   |   -acpid
|   |   -atd
|   |   -auditd--audispd--sedispatch
|   |   |
|   |   |   {audispd}
|   |   |   {auditd}
|   |   |
|   |   |   -avahi-daemon--avahi-daemon
|   |   |   -bonobo-activat--{bonobo-activat}
|   |   |   -cimservr--3*[{cimservr}]
|   |   |   -clock-applet
|   |   |   -console-kit-dae--63*[{console-kit-da}]
```

```
| -crond
| -cupsd
| -2*[dbus-daemon--{dbus-daemon}]
| -2*[dbus-launch]
| -devkit-disks-da--devkit-disks-da
| -devkit-power-da
| -evolution--7*[{evolution}]
| -evolution-alarm--{evolution-alarm}
| -evolution-data--2*[{evolution-data}]
| -gconf-im-settin
| -gconfd-2
| -gdm-binary--gdm-simple-slave--Xorg
| -gdm-session-war--gnome-session--abrt-applet
|
|   |
|   |   -bluetooth-applet
|   |   -gdu-notificatio
|   |   -gnome-panel--{gnome-panel}
|   |   -gnome-power-man
|   |   -gnome-volume-co
|   |   -gpk-update-icon--{gpk-
update-ico}
|
|   |   -metacity--{metacity}
|   |   -nautilus--{nautilus}
|   |   -nm-applet
|   |   -polkit-gnome-au
```

The above output shows the process tree on my system (starting with the *init* process). The *init* process is the first one to be executed by the

conditions, the resulting process is given the new security context. When there are no such rules, the new process inherits the security context of its parents.

To check all type transition rules that apply to processes (classes of type process), issue the following commands:

```
[root@vbg-work ~]# research -T -c process
type_transition user_wine_t fusemount_exec_t : process mount_t;
type_transition staff_execmem_t nsplugin_config_exec_t : process nsplugin_config_t;
type_transition insmod_t fusemount_exec_t : process mount_t;
type_transition xend_t fusemount_exec_t : process mount_t;
type_transition sysadm_java_t fusemount_exec_t : process mount_t;
type_transition ricci_modservice_t fail2ban_initrc_exec_t : process initrc_t;
type_transition init_t afs_bosserver_exec_t : process afs_bosserver_t;
type_transition hotplug_t dictd_initrc_exec_t : process initrc_t;
type_transition ricci_modservice_t sssd_initrc_exec_t : process initrc_t;
type_transition init_t apmd_exec_t : process apmd_t;
type_transition qmail_local_t qmail_queue_exec_t : process qmail_queue_t;
type_transition staff_execmem_t gpg_agent_exec_t : process gpg_agent_t;
...
```

Based on the above rules, the syntax of type transition rules that apply to processes can be understood as:

```
type_transition [Parent Process Type] [Type of File being executed
to create a process] : process [Type of The New Process created]
```

To check the above rules, let us look at the example of the Web server process discussed earlier.

When executing the executable `/usr/sbin/httpd` directly to create the `httpd` process:

- The parent process is the shell (because we are executing the command `/usr/sbin/httpd` under the Bash shell).
- The type of the parent process is `unconfined_t`. (Execute the following command to check.)

```
[root@vbg-work ~]# ps axZ | grep bash
unconfined_u:unconfined_r:unconfined_t:s0-s0:c0.c1023 2460 pts/0 Ss  0:00 bash
```

- The type of the file being executed is `httpd_exec_t`. (Execute the following command to check.)

```
[root@vbg-work ~]# ls -lZ /usr/sbin/httpd
-rwxr-xr-x. root root system_u:object_r:httpd_exec_t:s0 /usr/sbin/httpd
```

Let us check in our policy if such a rule exists:

```
[root@vbg-work ~]# research -T -c process | grep httpd_exec_t | grep unconfined_t
[root@vbg-work ~]#
```

This shows that we do not have a type transition rule to set the security context of new processes created by executing files of type `httpd_exec_t` under a parent process of type `unconfined_t`. In such a scenario, i.e., in the absence of any type transition rule, the new process takes the type of the parent; therefore, the `httpd` process inherits its security context from Bash (which is `unconfined_t`).

Let us now analyse the other case. When starting the `httpd` service through initialisation scripts:

- The parent process is the shell (because we are executing the script `/etc/init.d/httpd` under Bash).
- The type of the parent process is `unconfined_t`. (Execute the following command to check.)

```
[root@vbg-work ~]# ps axZ | grep bash
unconfined_u:unconfined_r:unconfined_t:s0-s0:c0.c1023 2460 pts/0 Ss  0:00 bash
```

- The type of the file being executed is `httpd_initrc_exec_t` (Execute the following command to check.)

```
[root@vbg-work ~]# ls -lZ /etc/init.d/httpd
-rwxr-xr-x. root root system_u:object_r:httpd_initrc_exec_t:s0 /etc/init.d/httpd
```

Let us check in our policy if such a rule exists:

```
[root@vbg-work ~]# research -T -c process | grep \
httpd_initrc_exec_t | grep unconfined_t
type_transition unconfined_t httpd_initrc_exec_t : process initrc_t;
[root@vbg-work ~]#
```

Finally, we have found a match. This rule states that if a file of type `httpd_initrc_exec_t` is executed under a parent process of type `unconfined_t`, the resulting process should get a type of `initrc_t`. This is good, but we had observed that the Web server process had a type of `httpd_t` and this rule states that the type of the resulting process is `initrc_t`. Is there an error? Is there something missing?

There is, indeed, something missing. It is important to note that the Web server process is created on executing the binary file (`/usr/bin/httpd`). Therefore, the init script actually executes this file.

But what happens is that the shell script process created by executing the initialisation script (`/etc/init.d/httpd`) is now running with a process security context bearing the type `initrc_t` (as per the rule above). When this process further executes the Web server binary (`/usr/sbin/httpd`), a new context is created. Therefore, there is another scenario that comes into play here, which is:

- The parent process is the shell script process created by executing the script `/etc/init.d/httpd`.
- The type of the parent process is `initrc_t` (because this is the type of process created by executing the init script from under Bash, as per the type transition rule above).
- The type of the file being executed is `httpd_exec_t` (as the shell script further executes the binary `/usr/sbin/httpd`). Execute the following command to check:

```
[root@vbg-work ~]# ls -lZ /usr/sbin/httpd
-rwxr-xr-x. root root system_u:object_r:httpd_exec_t:s0 /usr/sbin/httpd
```

Let us see if we have a type transition rule in the policy for the above:

```
[root@vbg-work ~]# research -T -c process | grep httpd_exec_t | grep initrc_t
type_transition initrc_t httpd_exec_t : process httpd_t;
[root@vbg-work ~]#
```


Voila! There it is, stating that if a file of type `httpd_exec_t` is executed under a parent process of type `initrc_t`, the resulting process created will have a security context type of `httpd_t`.

As an exercise, let us ensure that the `httpd` process, if executed directly under the shell, should also be created with a security context type of `httpd`. To do this, we will need to create a new module and insert it into our policy.

We will need to create a new type enforcement file as discussed in earlier articles. An example of the file is given below:

```
[vbg@vbg-work test-selinux]$ cat http.te
policy_module(http-1fy,1.1.0)
#####
#
# Declarations
#
require {
    type httpd_t;
    type unconfined_t;
    type httpd_exec_t;
    role unconfined_r;
    class process transition;
}
#####
#
# http local policy
#
type_transition unconfined_t httpd_exec_t : process httpd_t;
role unconfined_r types httpd_t;
allow unconfined_t httpd_t:process transition;
[vbg@vbg-work test-selinux]$
```

Compile and load this module:

```
[vbg@vbg-work test-selinux]$ make http.pp
[vbg@vbg-work test-selinux]$ su -
[root@vbg-work ~]# semodule -i /home/vbg/test-selinux/http.pp
```

Now execute the command `/usr/sbin/httpd` and note the security context type of the `httpd` process:

```
[root@vbg-work ~]# /usr/sbin/httpd
[root@vbg-work ~]#
[root@vbg-work ~]# ps axZ | grep http
unconfined_u:unconfined_r:httpd_t:s0-s0:c0.c1023 4343 ? Ss 0:00 /usr/sbin/httpd
unconfined_u:unconfined_r:httpd_t:s0-s0:c0.c1023 4345 ? S 0:00 /usr/sbin/httpd
unconfined_u:unconfined_r:httpd_t:s0-s0:c0.c1023 4346 ? S 0:00 /usr/sbin/httpd
unconfined_u:unconfined_r:httpd_t:s0-s0:c0.c1023 4347 ? S 0:00 /usr/sbin/httpd
unconfined_u:unconfined_r:httpd_t:s0-s0:c0.c1023 4348 ? S 0:00 /usr/sbin/httpd
unconfined_u:unconfined_r:httpd_t:s0-s0:c0.c1023 4349 ? S 0:00 /usr/sbin/httpd
unconfined_u:unconfined_r:httpd_t:s0-s0:c0.c1023 4350 ? S 0:00 /usr/sbin/httpd
unconfined_u:unconfined_r:httpd_t:s0-s0:c0.c1023 4351 ? S 0:00 /usr/sbin/httpd
unconfined_u:unconfined_r:httpd_t:s0-s0:c0.c1023 4352 ? S 0:00 /usr/sbin/httpd
unconfined_u:unconfined_r:unconfined_t:s0-s0:c0.c1023 4354 pts/0 S+ 0:00 grep http
[root@vbg-work ~]#
```

But how is the type of the first process (`init`) set? Does it inherit its type from the kernel? What exactly happens?

The following lines are taken verbatim from Dan Walsh's blog (<http://danwalsh.livejournal.com>): "When the SELinux kernel boots up, it is hard coded to run as `kernel_t`. Since at this point there is no policy running, this is the only context. So since this is the only context, all applications that are run will stay in `kernel_t`. When the kernel executes `/sbin/init` it originally is running as `kernel_t`, then it reads in the policy file and loads it into the kernel. At this point `init` re-execs itself. When `/sbin/init` was installed it is labelled `init_exec_t` and now there is a rule in the kernel that says when `kernel_t` execs an application labelled `init_exec_t`, it should transition to `init_t`. So now the `init` process is running as `init_t`."

Let us check if such a rule really exists in the policy, which applies when `init` re-executes itself:

- The parent process is the kernel.
- The parent process type is `kernel_t`.
- The file being executed is `/sbin/init`.
- The security context type of the file being executed is `init_exec_t`:

```
[root@vbg-work ~]# ls -lZ /sbin/init
-rwxr-xr-x. root root system_u:object_r:init_exec_t:s0 /sbin/init
```


Search the SELinux policy for a type transition rule:

```
root@vbg-work ~]# sestatus -T -c process | grep init_exec_t | grep kernel_t
type_transition kernel_t init_exec_t : process init_t;
```

There we are! When `/sbin/init` is executed under `kernel_t`, the `init` process being created has a type of `init_t`. This can be checked by the following command:

```
[root@vbg-work ~]# pstree -pZ | head -n 1
init(1, 'system_u:system_r:init_t:s0')
[root@vbg-work ~]#
```

Now we can understand how subjects or processes created in memory get their security contexts. Applying SELinux policy rules under type enforcement is simply allowing access only to desired objects by the designated subjects, and once we know how to set the security context types of objects and subjects, and how to create allow rules, we can easily achieve the best out of SELinux.

In the next article in this series, we will explore macros and dive deep into them. Do let me know if you have any queries. 

By: Varad Gupta

Varad is an open source enthusiast who strongly believes in the open source collaborative model not only for technology but also for business. India's first RHCSS (Red Hat Certified Security Specialist), he has been involved in spreading open source through Keen & Able Computers Pvt Ltd, an open source systems integration company, and FOSTERING Linux, a FOSS training, education and research training centre. The author can be contacted at varad.gupta@fosteringlinux.com



Tips & Tricks

Solve an X/display issue in VLC

Do you ever face problems opening VLC in Fedora (or for that matter, in any other distro)? You might have often come across errors like, "Could not connect to X server," or "Could not open display." VLC won't run as the root. A simple solution is to disable xServer access control. Type the following command to achieve this (you need to be the root user to execute this):

```
xhost *
```

Now you can go back to being a non-root user and run VLC player.

— Purna Chandar,

purnachandar.midi@oneconvergence.com

Using 'or' in grep

grep is a wonderful tool that helps you search for a particular word, or words, in files. So, how do we use the 'or' operator in grep (for example, if we want grep to look for either 'www' or 'server' when searching)? Issue the following command:

```
grep 'www|server' /etc/httpd/conf/httpd.conf
```

— Remin Raphael, remin13@gmail.com

Inserting sudo insults for when a wrong password is entered

Edit the `/etc/sudoers` file:

```
sudo visudo
```

Add insults in the line that begins with 'Defaults', which should look like what follows:

```
Defaults      insults
```

Save the file. Now, whenever you type your sudo password wrong, sudo will insult you with a random phrase. Go ahead and check it out; it could be fun.

— Bhuvanesh Kumar, bhuvibhuvanesh@gmail.com

When to use xargs

If a command is expecting arguments instead of standard input, then piping will fail (i.e., `cmd1 | cmd2` may not work). In such cases, `xargs` will be helpful. It supplies standard input as arguments to a given command (the command itself is passed as an argument to `xargs`):

```
cmd1 | xargs cmd2 #works fine
```

For example:

```
find <location> -name <filepattern> | xargs grep <searchpattern>
```

...or:

```
find <location> -name <filepattern> | xargs rm -f
```

— Rajesh Sola, rajesh@lisor.org

Find out the time taken for a command's execution

You can use the `time` command to find out the actual time that elapses between the invocation and termination of a command, the CPU time used by the command in user mode, and the CPU time used by the command in system mode. For example, here is the output of `ps`, timed by using the `time` command:

```
$ time ps
      PID TTY          TIME CMD
  7795 pts/2    00:00:00 bash
  8009 pts/2    00:00:00 ps
real    0m0.003s
```



```
user 0m0.001s
sys 0m0.001s
```

— **Abhishek Tanwar**, abhishek.tanwar@gmail.com

A smart monitor for /proc

Sometimes, while working on a system with a heavy load, you need to monitor the processing and working load (or memory load) to ensure the uninterrupted operation of the system.

For this purpose, you need to monitor the `/proc` directory. But it's not so easy—you need to check every file to monitor their different status. Or you need to use commands like `$free`, `$nice`, etc. All this is very time consuming.

The command line tool `$procinfo` comes to the rescue here. With this, you can easily monitor and get different status reports of the system, such as:

1. Physical memory information
2. Boot-up timing
3. Average number of running jobs
4. Amount of time spent running jobs in each user space
5. Time spent running jobs in kernel space
6. Time spent running jobs in each user niced space
7. Swap-in and Swap-out status
8. Idle time
9. Number of times your hard disk is accessed
10. All available filesystems
11. Interrupt status
12. Character and block devices

Try `$procinfo -a` to know the status of all the above parameters and see the results.

— **Amit N. Bhakay**, amit.nb@gmail.com

Password-less log-ins

If you want to log in to any user account or even as the root, without entering a password, then follow these steps. Open the `/etc/passwd` file in your text editor and go to the following line:

```
root:x:0:0:root:/root:/bin/bash
```

Delete the second field (that is 'x') and save this file. You can also do this for other users as:

```
vik:x:500:500:vik:/home/vik:/bin/bash
```

Now reboot the system and try logging in without the user password.

— **Vikash Kumar Jha**, v4evervikash@gmail.com

Setting up an email alert when the root filesystem is almost full

When the root filesystem of your GNU/Linux systems is full, your system might stop working without any notification. So how will one know this might be the cause for the shutdown? Don't worry, there is a simple solution. The following command will show the amount of disk space used on the root partition:

```
# df / | grep / | awk '{ print $5 }'
```

Now you can create a script, which can be added to `crontab` and it will email you whenever the disk's free space drops to less than the critical amount, say 10 per cent. Here is a sample script:

```
#!/bin/bash
CURRENT=$(df / | grep / | awk '{ print $5 }' | sed 's/%//g')
THRESHOLD=90

if [ "$CURRENT" -gt "$THRESHOLD" ];
then

    mail -s "Disk Space Alert" mail@domainname.com << EOF
    Your root partition remaining space is critically low. Used:
    $CURRENT%
    EOF
fi
```

Now save this into a `sample.sh` file in your home directory and add the following line at the end of the `/etc/crontab` file:

```
@daily ~/sample.sh
```

That's it! Now whenever your root filesystem grows to beyond 90 per cent of the total partition size, you get a notification. So you can take the required steps to free up space before you reach the deadlock.

— **Mallikarjun**, mallik.v.arjun@gmail.com



Share Your Linux Recipes!

The joy of using Linux is in finding ways to get around problems—take them head on, defeat them! We invite you to share your tips and tricks with us for publication in LFY so that they can reach a wider audience. Your tips could be related to administration, programming, troubleshooting or general tweaking. Submit them at www.linuxforu.com. The sender of each published tip will get an LFY T-shirt.



Sandya Mannarswamy

Welcome back to 'CodeSport'. In this month's column, we discuss mechanisms for design patterns that can help simplify object-oriented programming and facilitate software reuse.

Many readers had sent their answers to the questions we featured in the January edition. Congratulations to our readers K. Madhu and Joseph Raj for their correct solutions to all the questions.

I have received requests from a few readers to discuss software reuse and design patterns, so over the next few months, we will focus on these topics. Presently, we will look at how design patterns can help software reuse. We assume that the reader is familiar with basic object-oriented programming concepts.

Software reuse

The importance of software reuse has been widely understood and is a major advantage of object-oriented programming. There are two possible ways of reusing functionality in object-oriented programming. One is through class inheritance and the other is through object composition.

Reuse by class inheritance

Using class inheritance, we can define the implementation of one class in terms of another. Consider the often quoted example of a class hierarchy that defines a base class called 'Employee' and a derived class 'Manager', which is derived from this base class. By deriving the 'Manager' class from the 'Employee' class, we do not have to rewrite the employee functionality needed in the Manager class, since a Manager is also an Employee. Only newer functionality pertaining to the management function of the Manager class needs to be defined and implemented. This form of reuse is known as 'White box reuse', since typically, when reused through class inheritance, the internals of the base class are visible/exposed to the derived classes.

While reuse by class inheritance is easy, it has some disadvantages as well. Since class inheritance is defined at compile time, the implementations inherited from the base classes can not be changed dynamically at runtime. The second major disadvantage is that sub-classing often results in exposing the base class implementation to the derived class. In many real-life cases, the implementation of a derived class is so closely tied up with the implementation details of the base class, that any change in the base class will impact the derived class as well.

Consider the following class representation where we have the Employee class which represents an employee,

and a Manager class that inherits from it. Let us assume that the dates are represented as dd-mm-yyyy in the Employee class, and we have a method in the Employee class, namely PrintDateOfJoining, which prints the date of joining in DD-MM-YY format. Now what if the Manager class was designed so that it has a *Print* method that prints the Manager details as given in the code snippet below:

```
void Manager::Print()
{
    printf("employee id: %d name: %s\n", this->id, this->name)
    printf ("date of joining (dd-mm-yy) is:\n");
    this->PrintDateofJoining();
}
```

In this snippet, the *Print* method in the derived Manager class calls the PrintDateOfJoining method. If this method was redesigned to print the date as DD-MM-YYYY format, the *Print* method needs to change the printing of the title message as:

```
void Manager::Print()
{
    printf("Manager id: %d name: %s\n", this->id, this->name)
    printf ("date of joining (dd-mm-yyyy) is:\n");
    this->PrintDateofJoining();
}
```

This is a bad design since the base class implementation of printing dates as DD-MM-YY was exposed to the derived class. This dependence meant that the derived class needed to change when there was a change in the base class implementation of printing the date of joining. The problem occurred because the base class implementation was inherited assuming a certain underlying representation. When the underlying representation in the base class changed, that required a corresponding change in the derived class, which is undesirable. A simple code change could have avoided the dependency as shown below:

```
void Manager::Print()
{
    printf("Manager id: %d name: %s\n", this->id, this->name)
    printf ("date of joining (%) is:\n",
```



```
GetEmployeeDateFormat();
    this->PrintDateofJoining();
}
```

By removing the assumption about the base class implementation and invoking the base class method that advertises its date format, we have been able to avoid the change to the derived class implementation when the base class implementation changes.

Reuse by object composition

Reusing functionality by object composition is another form of enabling reuse. Various objects that offer the required functionality are composed together into a composite object, by including references to those objects. The functionality of the objects being included in the composite object gets reused through well-defined interfaces provided by these objects. The composite object is insulated from the implementation internals of the objects it is composed of. Hence, this form of reuse is known as 'Black box reuse'.

Let's assume that you are designing a holiday vacation package. You already have designed the classes 'HotelRoom', 'Car' and 'Passenger'. You can reuse these classes to create the 'Vacation Trip' class, which includes object references for hotel rooms, cars and passengers. For example, if the 'Vacation Trip' class includes a method called 'MakeReservation', it will reuse the functionality from the composed objects by invoking the interfaces 'Car::Reserve' and 'HotelRoom::Reserve'.

Since the methods are invoked using object references, the object encapsulation of the composing objects is not broken. Also, it is possible to change the object composition at runtime as long as the new object has the same type as the object it is replacing. However, object composition requires that well-defined interfaces are needed in the objects that are used for composition.

Design patterns—preliminaries

You may be wondering why we are discussing software reuse so much in an article on design patterns. Increasing software reuse was one of the motivational factors in the birth of design patterns. Software applications are complex applications running from thousands to millions of lines of code, involving interaction between a large number of objects. However, a study of large real-world software applications has shown that there is a great degree of commonality in some of the sub-problems that are part of a complex project.

Often, each software project requires visiting some data structure, say a graph or linked list, and performing a specific operation on each member. For instance, a simple find on a linked list maps to a visitor pattern, which performs an equality check on each member. Similarly, doing a depth first numbering on a graph requires visiting a graph in a particular order and performing numbering on each node as it is encountered during the traversal.

Design patterns allow us to identify frequently encountered problems during application development and to specify a solution template that can be applied to a variety of situations. While the software reuse we have been discussing so far has


been with respect to software functionality, a greater and more fundamental question is whether design reuse is possible.

If there is a frequently encountered problem in software programming, can the design of the solution be templatised as a pattern so that it can be applied under different contexts? Design patterns try to extract the common design structure that can then be reused under various contexts by different concrete implementations.

Now you may ask—how is a design pattern different from a standard template library algorithm? An algorithm in the STL library provides an implementation of a particular algorithm, defined in terms of parameterised types so that it can be used with different types. It is a concrete implementation of a solution. On the other hand, a design pattern only provides a template of a design that can be used under different situations.

Let's consider a situation in which you have to implement a compiler. There can be only one instance of a global symbol table and all modules should be able to access it, while no one can be allowed to create multiple instances of it. Similarly, if you are writing an operating system, you need to ensure that only one instance of the file system or scheduler is instantiated even if there are multiple threads running. Hence, the problem of ensuring that a particular class has only one instance and has global access, comes up multiple times in a software development environment. So, if we can find an abstract solution for this problem which can be applied under different contexts, then we have a design pattern. This is known as the Singleton design pattern, which we will discuss in detail next month.

This month's takeaway question continues our discussion of the Singleton design pattern. Can you come up with a C++ implementation for a Singleton design pattern? Please do not look up the solution from the Internet. Our intention is just not to know the answer, but to become effective in designing solutions. Instead, try to come up with your design for the Singleton design pattern. While a naïve approach would be to have a global or static object of a class as a singleton, there are a number of problems associated with such a simple approach. I leave it to the reader to ponder over possible issues and come up with a robust design. Also, you need to ensure that your design works in a multi-threaded environment.

Please do send me your solutions. Also, if you are preparing for computer science programming interviews, you may find it useful to visit my programming interviews discussion group 'Computer Science Interview Training (India)' on LinkedIn. If you have any favourite programming puzzles that you would like to discuss on this forum, please send them to me along with your solutions and feedback at sandyasm_AT_yahoo_DOT_com. Till we meet again next month, happy programming! 

About the author:

Sandya Mannarswamy. The author is a specialist in compiler optimisation and works at Hewlett-Packard India. She has a number of publications and patents to her credit, and her areas of interest include virtualisation technologies and software development tools.



Understanding Pointer Arithmetic, Part 1

Pointers are most difficult to master in C. In this article, we'll cover the basics of pointer arithmetic and look at how it is different from what we've learned in high school.

What are pointers? There are many different answers to this question. Simply stated, *a pointer is an address!* A longer answer would be that *a pointer is an abstraction of the concept of the 'address of a memory location'.* Yes, it's an unusual description, and I'll explain its meaning in this article.

It's quite tedious to directly write machine code (in ones and zeros). Assembly code helps us write machine code almost directly, since it has mnemonics for machine instructions. An assembler is (conceptually) a simple program that translates these human-readable mnemonics to machine opcodes. C is close to machine (and assembly) code, and we'll look at C data types as an example for that.

At the lowest level, information is stored and manipulated as bytes, words, double-words, etc. In C, bytes are chars (there is no byte type in C; the closest is unsigned or signed char); words are ints (integers); and double words are longs (long integers). In a floating point unit, data can be in single-, double- or extended-precision. In C, it is float, double and long double types. Apart from this, we can take addresses of memory locations—that address type is treated as a pointer in C!


Since pointers are an abstraction of addresses, the arithmetic on pointers is different from usual arithmetic. For example, in assembly coding, to access a value in location *idx* in an array named *arr*, you add an index to the base address, and then read the value from that location. In C, the base address is the name of the array (*arr*); index is an integral value (*idx*) and accessing that index is given by the expression *arr + idx*. Now, to access the data in that location, we use the indirection operator (read operation). In other words, it is `int val = *(arr + idx);`, which is logically the same in C as well as in assembly language.

Now assume that *arr* is of *int* type of size 4 bytes, and index is 10 for an imaginary base address, where *arr* = `0xAAAA0000`. If we access 10 bytes from the base address, it will be `0xAAAA000A`, which will be wrong. What we

need to access is *arr + sizeof(word) * 10*. Hence, *arr + 40*, which is `0xAAAA0028`. If the underlying array is *dword* (long int), and we want to access the 10th location, the same expression *arr + idx* will be *arr + sizeof(dword) * 10*, which is `0xAAAA0050`. In other words, depending on the type of the array *arr*, the *+* operator behaves differently. If it were a char array (as in strings), the index operation for *arr + idx* would have added exactly 10 to the base address, which is `0xAAAA000A`.

This is precisely how pointer arithmetic works in C! We need to assume that pointers point to somewhere in an array (even if such an array doesn't exist in our program). Adding a constant to that pointer is as if we are doing an array index, and the result depends on the type of the (logical) underlying array. When we don't know what type of the (logical) array we are pointing to, we call it a void *. As you can understand now, we cannot do arithmetic on a void * since the compiler will not know the underlying type.

In assembly language, we can store an address in a place. Let's suppose that I want to remember the base address *arr* in a memory location *addrvar*. Now, if I need to access the value in *arr* through *addrvar* (whose value will be the same as **arr* or *arr[0]* in the equivalent C expression), we need to first get the value stored in *addrvar* and then get the value stored *inside that value*. This is nothing but double de-reference, and *addrvar* is nothing but a pointer to a pointer! Now we can understand how pointers-to-pointers work, and how an array of pointers-to-pointers (oh man!) will work.

In other words, once you understand how the underlying machine treats addresses, you can easily understand how pointers and pointer arithmetic work in C. **END** 

About the author:

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A Voyage to the Kernel



Part 22

Segment: 4.2, Day 21

In the previous article, we'd looked at how to add more features to a module. But you couldn't call what we'd created a 'device driver'. In this article, we will devote our time to developing a driver for a simple 'device'. As we discussed before, Linux treats devices as files. You may scan through your `/dev/` directory to see the listing. It is through the addition of a file node in this directory that we make a physical device accessible.

You may notice that many files are listed in this directory. This does not mean that all these files (devices) are active. Issue the following command to see the active ones:

```
cat /proc/devices
```

We have also seen that there are character and block devices. (We looked at network devices as well.) The type of the device informs us about the way in which data will be written to the corresponding device. In the case of a character device, it is added serially (byte by byte) and for a block device, the data is added as large segments (an ideal example will be HDD).

Now I am going to list the active devices in my system:

```
aasisvinayak@GNU-BOX:~$ cat /proc/devices
```

Character devices:

```
1 mem
4 /dev/vc/0
4 tty
4 ttyS
5 /dev/tty
5 /dev/console
5 /dev/ptmx
6 lp
7 vcs
10 misc
13 input
14 sound
21 sg
29 fb
```

```
81 video4linux
99 ppdev
108 ppp
116 alsa
128 ptm
136 pts
180 usb
189 usb_device
```

<<<OUTPUT TRUNCATED>>>

Here I can see some names and a numerical value. The numeral is actually the major number associated with the device driver. (We will discuss major and minor numbers after writing the code for the new driver.)

Having got this information, I can now allocate a major number that has not been assigned previously. All I need to note is that the new number should not be on this list.

Now let me show you the complete code for the new driver:

```
#include "LFY_device_header.h"
#include <linux/module.h>
#include <linux/init.h>

MODULE_AUTHOR("Aasis Vinayak PG");
MODULE_DESCRIPTION("Written for Voyage to Kernel");

static int lfy_device_init(void);
static void lfy_device_cleanup(void);

module_init(lfy_device_init);
module_exit(lfy_device_cleanup);

static int lfy_device_init(void)
{
    if(register_chrdev(161, "LFY_device", &lfy_ops))
    {
        printk("<1>failed to register");
    }
    return 0;
}
```

```

}
static void LFY_device_cleanup(void)
{
    unregister_chrdev(161, "LFY_device");
    return ;
}

```

As you can see, the above module code contains an include statement for the file `LFY_device_header.h`. This is a custom header file for our driver. Let me show you that file as well:

```

#ifndef _LFY_DEVICE_H
#define _LFY_DEVICE_H
#include <linux/fs.h>
#include <linux/sched.h>
#include <linux/errno.h>
#include <asm/current.h>
#include <asm/segment.h>
#include <asm/uaccess.h>

char LFY_device_data[80]="Sample data - A Voyage to Kernel";
int LFY_device_open(struct inode *inode,struct file *fhp);
int LFY_device_release(struct inode *inode,struct file *fhp);
ssize_t LFY_device_read(struct file *fhp,char *buffer,size_t count,loff_t *offp );
ssize_t LFY_device_write(struct file *fhp,const char *buffer,size_t
count,loff_t *offp );

struct file_operations LFY_ops={
    open: LFY_device_open,
    read: LFY_device_read,
    write: LFY_device_write,
    release:LFY_device_release,
};

int LFY_device_open(struct inode *inode,struct file *fhp)
{
    return 0;
}

int LFY_device_release(struct inode *inode,struct file *fhp)
{
    return 0;
}

ssize_t LFY_device_read(struct file *fhp,char *buffer,size_t count,loff_t *offp )
{
    if (copy_to_user(buffer,LFY_device_data,strlen(LFY_device_data)) != 0 )
        printk( "User-space - copy failed\n" );
    return strlen(LFY_device_data);
}

ssize_t LFY_device_write(struct file *fhp,const char *buffer,size_t
count,loff_t *offp )
{
    if ( copy_from_user(LFY_device_data,buffer,count) != 0 )
        printk( "Copy failed\n" );
    return 0;
}
#endif

```

Now, let's analyse the code. One of the important files that the code is referring to is the `linux/fs.h` file. The `file_operations` structure is described in this file. And if you look at this file carefully, you can see that it contains the necessary pointers to functions that we used in our driver. In the case of an actual device, this will help you in performing the basic operations on your device. Here, each field is linked to the address of a function that we used in the driver. The basic operations, like reading, writing, etc, are handled using these.

For your reference, here is the `struct file_operations` code:

```

struct file_operations {
    struct module *owner;
    loff_t (*llseek) (struct file *, loff_t, int);
    ssize_t (*read) (struct file *, char __user *, size_t, loff_t *);
    ssize_t (*write) (struct file *, const char __user *, size_t, loff_t *);
    ssize_t (*aio_read) (struct kiocb *, const struct iovec *, unsigned
long, loff_t);
    ssize_t (*aio_write) (struct kiocb *, const struct iovec *, unsigned
long, loff_t);
    int (*readdir) (struct file *, void *, filldir_t);
    unsigned int (*poll) (struct file *, struct poll_table_struct *);
    int (*ioctl) (struct inode *, struct file *, unsigned int, unsigned long);
    long (*unlocked_ioctl) (struct file *, unsigned int, unsigned long);
    long (*compat_ioctl) (struct file *, unsigned int, unsigned long);
    int (*mmap) (struct file *, struct vm_area_struct *);
    int (*open) (struct inode *, struct file *);
    int (*flush) (struct file *, fl_owner_t id);
    int (*release) (struct inode *, struct file *);
    int (*fsync) (struct file *, struct dentry *, int datasync);
    int (*aio_fsync) (struct kiocb *, int datasync);
    int (*fasync) (int, struct file *, int);
    int (*lock) (struct file *, int, struct file_lock *);
    ssize_t (*sendpage) (struct file *, struct page *, int, size_t,
loff_t *, int);
    unsigned long (*get_unmapped_area)(struct file *, unsigned long,
unsigned long, unsigned long, unsigned long);
    int (*check_flags)(int);
    int (*flock) (struct file *, int, struct file_lock *);
    ssize_t (*splice_write)(struct pipe_inode_info *, struct file *,
loff_t *, size_t, unsigned int);
    ssize_t (*splice_read)(struct file *, loff_t *, struct pipe_inode_
info *, size_t, unsigned int);
    int (*setlease)(struct file *, long, struct file_lock **);
};

```

You may also find that many operations are supported by this file. It will even help you to perform many other tasks like reading a directory structure and so on. In our case, we are not performing these types of operations. So you can set the corresponding entries to null. In our code, we used the following format:

```

struct file_operations LFY_ops={
    open: LFY_device_open,
    read: LFY_device_read,
    write: LFY_device_write,

```



```

    release:LFY_device_release,
}

```

You may note that some modern drivers use another format, as shown below:

```

struct file_operations LFY_ops = {
    open = LFY_device_open,
    read = LFY_device_read,
    write = LFY_device_write,
    release = LFY_device_e_release
};

```

This is supported by a GCC extension and is helpful if you want to port your device driver. You can use the old format for this tutorial.

Similarly, `/dev/` is represented by a file structure (you may look at `linux/fs.h` for more details). There are a few points that you should note here. The 'file' (in this context) is a kernel-level structure and never goes to the user-space program level. But you should not mistake this for `FILE`, which is defined by the glibc library and is not a part of the kernel-space function. Our 'file' is not a file on the disk but rather an 'abstract open file', represented by `inode` (struct).

Also, we have the `inode_operations`. For your information, here is the `struct inode_operations`:

```

struct inode_operations {
    int (*create) (struct inode *, struct dentry *, int, struct nameidata *);
    struct dentry * (*lookup) (struct inode *, struct dentry *, struct
nameidata *);
    int (*link) (struct dentry *, struct inode *, struct dentry *);
    int (*unlink) (struct inode *, struct dentry *);
    int (*symlink) (struct inode *, struct dentry *, const char *);
    int (*mkdir) (struct inode *, struct dentry *, int);
    int (*rmdir) (struct inode *, struct dentry *);
    int (*mknod) (struct inode *, struct dentry *, int, dev_t);
    int (*rename) (struct inode *, struct dentry *,
        struct inode *, struct dentry *);
    int (*readlink) (struct dentry *, char __user *, int);
    void * (*follow_link) (struct dentry *, struct nameidata *);
    void (*put_link) (struct dentry *, struct nameidata *, void *);
    void (*truncate) (struct inode *);
    int (*permission) (struct inode *, int);
    int (*setattr) (struct dentry *, struct iattr *);
    int (*getattr) (struct vfsmount *mnt, struct dentry *, struct kstat *);
    int (*setxattr) (struct dentry *, const char *, const void *, size_t, int);
    ssize_t (*getxattr) (struct dentry *, const char *, void *, size_t);
    ssize_t (*listxattr) (struct dentry *, char *, size_t);
    int (*removexattr) (struct dentry *, const char *);
    void (*truncate_range) (struct inode *, loff_t, loff_t);
    long (*fallocate) (struct inode *inode, int mode, loff_t offset,
        loff_t len);
    int (*fiemap) (struct inode *, struct fiemap_extent_info *, u64 start,
        u64 len);
}

```

Another important one is `filp`, which is the instance of file (struct):

```
extern int __f_setown(struct file *filp, struct pid *, enum pid_type, int force);
```

Here is the relevant code corresponding to the struct file:

```

struct file {
    /*
     * fu_list becomes invalid after file_free is called and queued via
     * fu_rcuhead for RCU freeing
     */
    union {
        struct list_head fu_list;
        struct rcu_head fu_rcuhead;
    } fu;
    struct path f_path;
#define f_dentry f_path.dentry
#define f_vfsmnt f_path.mnt
    const struct file_operations *f_op;
    spinlock_t f_lock; /* f_ep_links, f_flags, no IRQ */
    atomic_long_t f_count;
    unsigned int f_flags;
    fmode_t f_mode;
    loff_t f_pos;
    struct fown_struct f_owner;
    const struct cred *f_cred;
    struct file_ra_state f_ra;

    u64 f_version;
#ifdef CONFIG_SECURITY
    void *f_security;
#endif
    /* needed for tty driver, and maybe others */
    void *private_data;

#ifdef CONFIG_EPOLL
    /* Used by fs/eventpoll.c to link all the hooks to this file */
    struct list_head f_ep_links;
#endif
#ifdef CONFIG_SECURITY
    struct address_space *f_mapping;
#endif
#ifdef CONFIG_DEBUG_WRITECOUNT
    unsigned long f_mnt_write_state;
#endif
}

```

You may have noticed that we have used a major number in our code. This is used while registering the character device:

```

extern int register_chrdev_region(dev_t, unsigned, const char *);
extern int register_chrdev(unsigned int, const char *,
        const struct file_operations *);

```

The major number is employed to indicate the driver

to be used to access the hardware. And each driver will be assigned a unique major number. All device files carrying the same major number are handled by the same driver. As this number is unique, we earlier used `cat /proc/devices` to see the major number of the active devices.

You may also note that we have a minor number (which is a sort of internal number) that is used by the driver to identify the different hardware it can access. (See the output of `cat /proc/modules` in Figure 1.)

You can also see the minor and major numbers of the devices using `ls -l` command (Figure 2).

During the 'registration' (see the code given above), the *unsigned int* corresponds to the major number and the *const char ** refers to the name of the device (to appear in the output of `cat /proc/devices`). As we discussed earlier, we use the *struct file_operations ***fops* to refer to the 'file operations table'.

When you develop an actual device driver, it is advisable that you consult the documentation provided by your distribution to find out an unused major number.

Some of you might be wondering how we are going to use the driver we wrote, without having hardware (dev) to test. We can create a virtual one using the *mknod* command.

Before doing that, let us compile our driver. (If you find it hard to create a simple 'make file' for this, please refer to the previous article.)

If you look at the output (Figure 3), you will notice an error. This is because we forgot to add a licence statement in our code. You can remove the error by adding the following line to the code:

```
MODULE_LICENSE("GPL v3");
```

Now the driver has been compiled. Let's add (load) the driver to the kernel by issuing the following command:

```
sudo insmod LFY_dev.ko
```

It is time to create our device! We can do that by using the following command as the root user:

```
mknod /dev/LFY_device c 161 0
```

This actually creates a new file in the `/dev/` directory (Figure 4).

We have also specified (in the command) that it should be a character device (c) and the major number should be 161.

You can see the new major and minor numbers of the new device we created, by using the `ls -l` command—see Figure 5.

Our driver and device are ready for use. Let's send some data to the device (after becoming the root):

```
echo "Voyage to Kernel" > /dev/LFY_device
```

If you look at the code carefully you can see that this command can effectively keep on sending the data again and again. And now we can 'read' the device by issuing the following command:

```

aasisvinayak@GNU-BOX: ~
file Edit View Terminal Help

aasisvinayak@GNU-BOX:~$ cat /proc/modules
insfs 31620 1 - Live 0xf8ac4000
udf 80932 0 - Live 0xf8e90000
crc_itu 1 1052 1 udf, Live 0xf8ae5000
cbc 3516 832 - Live 0xf9475000
aes 1505 8124 833 - Live 0xf8ba0000
aes_generic 27404 1 aes 1500, Live 0xf87e4000
ecb 2524 1 - Live 0xf82a4000
binfmt_misc 8356 1 - Live 0xf5784000
pdpdev 6588 0 - Live 0xf9467000
vboxnetadp 78760 0 - Live 0xf9993000
vboxnetflr 85280 0 - Live 0xf5075000
vboxdrv 121608 1 vboxnetflr, Live 0xf9973000
dm_crypt 12928 0 - Live 0xf85a9000
brIDGE 47952 0 - Live 0xf8351000
stp 2272 1 brIDGE, Live 0xf8240000
bnep 12960 2 - Live 0xf8ce2000
btusb 31856 2 - Live 0xf8caf000
joydev 10240 0 - Live 0xf82bd000
snd_hda_codec_idt 59044 1 - Live 0xf8510000
snd_hda_intel 206904 2 - Live 0xf993a000
snd_hda_codec 75708 2 snd_hda_codec_idt, snd_hda_intel, Live 0xf9918000
snd_hwdsp 7280 1 snd_hda_codec, Live 0xf90f7000
lpablet_filter 3100 0 - Live 0xf90e0000

```

Figure 1: Output of `cat /proc/modules`

```

aasivinyayak@GNU-BOX: +
File Edit View Terminal Help
aasivinyayak@GNU-BOX:~$ ls -l /dev/
total 8
crw-rw-rw- 1 root video      18, 175 2018-02-16 09:15 sgpapp
crw-rw-rw- 1 root audio      14,  4 2018-02-16 09:16 audio
crw-rw-rw- 1 root root       18,  59 2018-02-16 09:16 bluetooth
drwx-r-x-x 1 root root      260 2018-02-16 09:15 block
drwx-r-x-x 1 root root       60 2018-02-16 09:15 bus
lrwxrwxrwx 1 root root       13 2018-02-16 09:16 cdrom -> /dev
lrwxrwxrwx 1 root root       13 2018-02-16 09:16 cdrom -> /dev
drwx-r-x-x 1 root root    3580 2018-02-16 09:16 char
crw-rw-rw- 1 root root       5,  1 2018-02-16 09:16 console
lrwxrwxrwx 1 root root       11 2018-02-16 09:16 console -> /proc/kcore
crw-rw-rw- 1 root root      10,  58 2018-02-16 09:15 crypto
drwx-r-x-x 1 root root     120 2018-02-16 09:15 crypto
drwx-r-x-x 1 root root       60 2018-02-16 09:15 dev
crw-rw-rw- 1 root audio      14,  3 2018-02-16 09:16 dev
lrwxrwxrwx 1 root root       13 2018-02-16 09:16 dev -> /dev
lrwxrwxrwx 1 root root       13 2018-02-16 09:16 dev -> /dev
crw-rw-rw- 1 root root      62 2018-02-16 09:15 encryptfs
crw-rw-rw- 1 root video     29,  8 2018-02-16 09:15 fb
lrwxrwxrwx 1 root root       13 2018-02-16 09:16 fb -> /proc/self/fd
crw-rw-rw- 1 root root       1,  7 2018-02-16 09:15 full
crw-rw-rw- 1 root fuse     10, 229 2018-02-16 09:15 fuse
crw-rw-rw- 1 root root     252,  8 2018-02-16 09:15 hidraw

```

Figure 2: Listing the devices with major and minor numbers

```
aasivvinayak@GNU-BOX: ~/Desktop/modules
File Edit View Terminal Help
aasivvinayak@GNU-BOX:~/Desktop/modules
aasivvinayak@GNU-BOX:~/Desktop/modules$ cd ~/Desktop/modules
aasivvinayak@GNU-BOX:~/Desktop/modules$ make
make -C /lib/modules/2.6.32-17-generic-pae/build M=/home/aasivvinayak/Desktop/modules modules
make[1]: Entering directory '/usr/src/linux-headers-2.6.32-17-generic-pae'
CC [M] /home/aasivvinayak/Desktop/modules/LFY_dev.o
Building modules, stage 2.
MODPOST 1 modules
WARNING: modpost: missing MODULE_LICENSE() in /home/aasivvinayak/Desktop/modules/LFY_dev.o
see include/linux/module.h for more information
CC /home/aasivvinayak/Desktop/modules/LFY_dev.mod.o
LD [M] /home/aasivvinayak/Desktop/modules/LFY_dev.ko
make[1]: Leaving directory '/usr/src/linux-headers-2.6.32-17-generic-pae'
aasivvinayak@GNU-BOX:~/Desktop/modules$
```

Figure 3: Compiling the driver

```
File Edit View Terminal Help
CPU dev Latency null
pica blfmem sda1 tty20 tty50 yboudry
dri pci0 sda2 tty21 tty51 yboudrytest1
J2C sda3 tty22 tty52 vc1
sda4 tty23 tty53 vc2
sda5 tty24 tty54 vc3
sda6 tty25 tty55 vc4
sda7 tty26 tty56 vc5
sda8 tty27 tty57 vc6
sda9 tty28 tty58 vc7
sda10 tty29 tty59 vc8
sda11 tty30 tty60 vc9
sda12 tty31 tty61 vc10
sda13 tty32 tty62 vc11
sda14 tty33 tty63 vc12
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sda17 tty36 tty66 vc15
sda18 tty37 tty67 vc16
sda19 tty38 tty68 vc17
sda20 tty39 tty69 vc18
sda21 tty40 tty70 vc19
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sda33 tty52 tty82 vc31
sda34 tty53 tty83 vc32
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sda24
```

Figure 4: Listing of /dev/ directory

Post: Linux Administrator
Company: Yahoo Software Development India Pvt. Ltd.
Profile: Incumbent should have good knowledge of Linux and will be responsible for Service Engineering and Operations.
Exp: 7-12
Location: Bengaluru
Email: lathav@yahoo-inc.com

Post: Linux Administrator
Company: E2E Infoware Management Services Pvt. Ltd.
Profile: Candidate should have great exposure to Linux.
Exp: 3-8
Location: Bengaluru
Email: ravi@e2einfoware.com

Post: Unix Administrator
Company: Crown Solutions India Pvt. Ltd.
Profile: Should have 5+ years of relevant experience in similar field.
Exp: 5-10
Location: Chennai
Email: sudha@crownsolution.com

Post: Unix Systems Engineer
Company: Tecnotree
Profile: Should be a UNIX Engineer with a complete understanding of Solaris and RedHat, Network Administration including TCP/IP, Network Routing, LAN / WAN, VLANs, Security, Unix Scripting, etc.
Exp: 5-10
Location: Bengaluru
Email: sunil.chandran@tecnotree.com

Post: Unix Administrator
Company: Kabul Bank
Profile: Hands on experience in administration of large Unix servers environment at enterprise level.
Exp: 2-5
Location: Afghanistan
Email: recexpat.kb@gmail.com

Post: Linux Administrator
Company: Yahoo Software Development India Pvt. Ltd.
Profile: Incumbent should have good knowledge of Linux and will be responsible for Service Engineering and Operations.
Exp: 7-12
Location: Bengaluru
Email: lathav@yahoo-inc.com

Post: Linux Administrator
Company: E2E Infoware Management Services Pvt. Ltd.
Profile: Candidate should have great exposure to Linux.
Exp: 3-8
Location: Bengaluru
Email: ravi@e2einfoware.com

Post: Unix Administrator
Company: Crown Solutions India Pvt. Ltd.
Profile: Should have 5+ years of relevant experience in similar field.
Exp: 5-10
Location: Chennai
Email: sudha@crownsolution.com

Post: Unix Systems Engineer
Company: Tecnotree
Profile: Should be a UNIX Engineer with a complete understanding of Solaris and RedHat, Network Administration including TCP/IP, Network Routing, LAN / WAN, VLANs, Security, Unix Scripting, etc.
Exp: 5-10
Location: Bengaluru
Email: sunil.chandran@tecnotree.com

Post: Unix Administrator
Company: Kabul Bank
Profile: Hands on experience in administration of large Unix servers environment at enterprise level.
Exp: 2-5
Location: Afghanistan
Email: recexpat.kb@gmail.com

Post: Sr. Engineer - Test Automation
Company: SafeNet Infotech
Profile: Should have 3-6 years relevant experience in Test Automation using C language, Perl, Shell, etc.). Good understanding of Linux OS.
Exp: 3-6
Location: Noida
Email: hrindia@safenet-inc.com

Post: Software Engineer (C++, GDB, Unix / Linux)
Company: XIUS-bcgi (A Division of Megasoft Ltd.)
Profile: Candidate should have 3-4 years experience and good C++ programming skills on Unix / Linux / Solaris.
Exp: 3-4
Location: Hyderabad
Email: shashi.mukkala@xius-bcgi.com

Post: Systems Programming - HP/UX, AIX
Company: Oracle India Pvt. Ltd.
Profile: Should be BS / MS Computer Science from Reputed Institute with 4+ years of research, design, and systems software product engineering experience.
Exp: 3-7
Location: Bengaluru
Email: achappa.bheemaiah@oracle.com

Post: Embedded Test Engineer - Linux
Company: Impetus-People
Profile: Applicant should have 2-4 years experience in testing Video drivers, graphics, video on Linux / Unix, RTOS.
Exp: 2-4, **Location:** Pune
Email: careers@impetuspeople.com

Post: Sr. Software Engineer - Clocks
Company: Atrenta India Pvt. Ltd.
Profile: Must have around 2-4 years of experience, with good knowledge of ASIC front end and / or back end EDA tools and exposure to HDLs. Exposure to Unix / Linux platforms.
Exp: 2-4
Location: Noida
Email: career@noida.atrenta.com



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- 80% of LFY readers are either decision influencers or decision takers
- Discounts for listing under multiple categories
- Discounts for booking multiple issues

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- Listing is categorised on the basis of products and services
- Complete contact details plus 30-word description of organisation
- Option to print the LOGO of the organisation too (extra cost)
- Option to change the organisation description for listings under different categories



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| <input type="checkbox"/> EMBEDDED SOLUTIONS | <input type="checkbox"/> LINUX-BASED WEB-HOSTING | <input type="checkbox"/> TRAINING FOR CORPORATE |
| <input type="checkbox"/> ENTERPRISE COMMUNICATION SOLUTIONS | <input type="checkbox"/> MOBILE SOLUTIONS | <input type="checkbox"/> THIN CLIENT SOLUTIONS |

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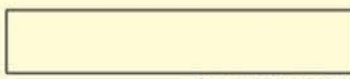
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C V V No. _____ (Mandatory)

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